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## (54) LIFTING DEVICE

(57) A lifting device (10), particularly suitable for lifting sheet materials, comprises a frame including two frame halves (14a, 14b) moveable between a retracted position and an extended position; two or more lifting hooks (12) depending from the frame; and an actuator (16). The frame halves are configured to be moved between the extended position and the retracted position by the actuator.

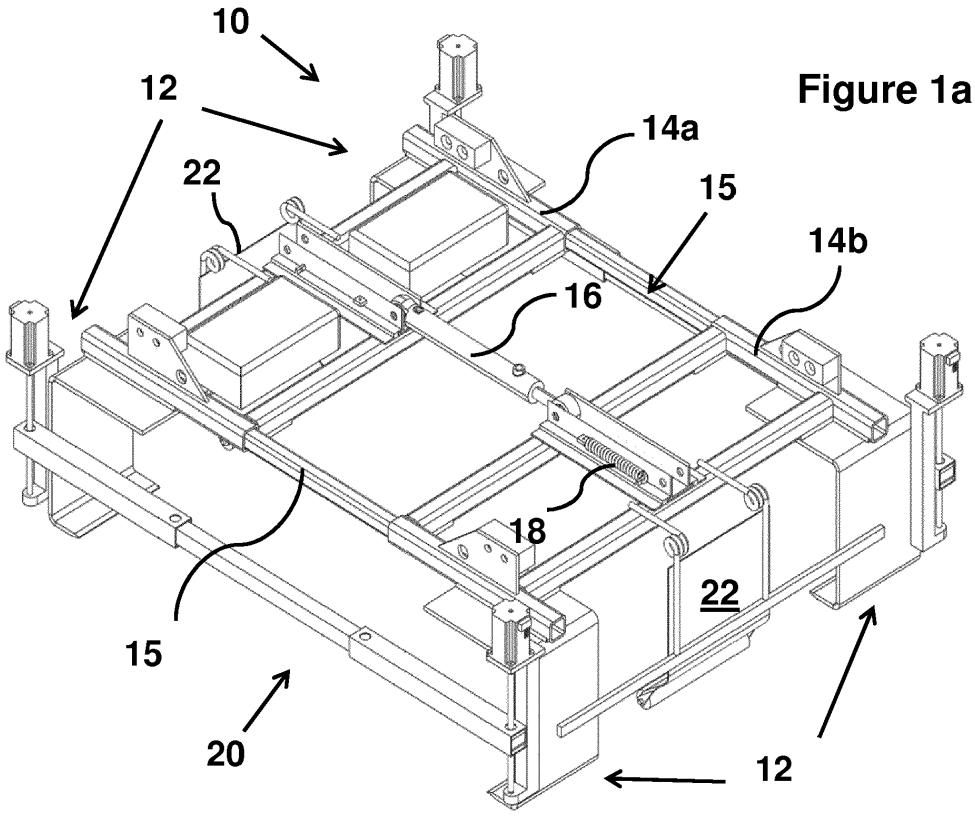


Figure 1a

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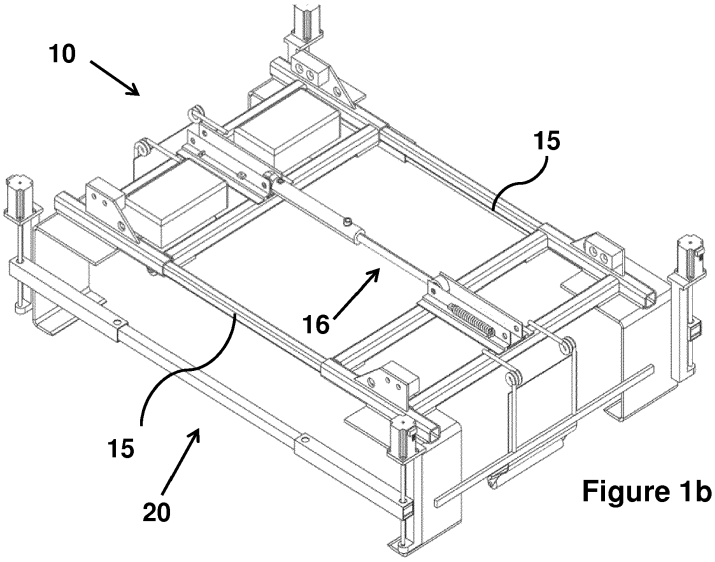



Figure 1b

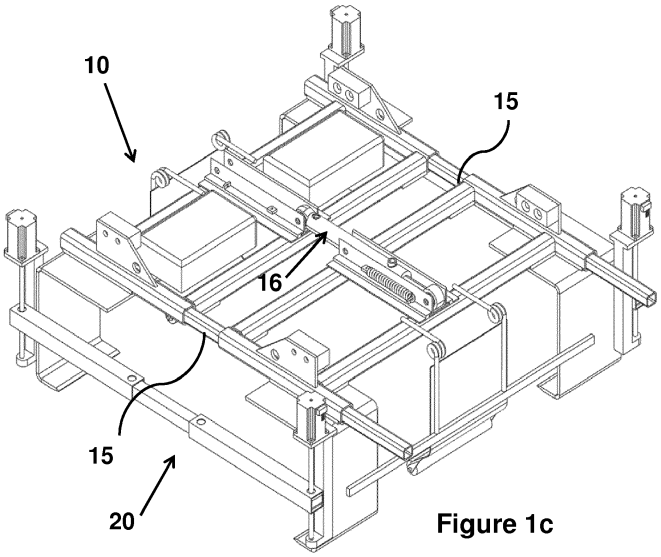



Figure 1c

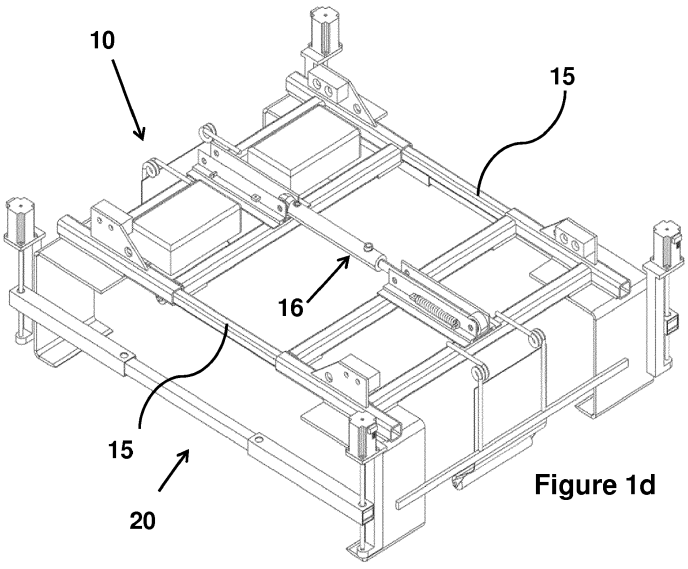



Figure 1d

## Description

### Technical Field

**[0001]** The present invention relates to a lifting device. In particular, but not exclusively, the present invention relates to a lifting device for lifting sheet materials.

### Background

**[0002]** Sheet material, such as plasterboard, is heavy and awkward to lift manually. Conventional lifting devices, such as forklift trucks and cranes, are known. However, such conventional devices may damage the material during lifting, particularly when it is desired to split or divide a stack of sheet material into one or more separate sheets.

**[0003]** US2646305A discloses a material handling device comprising a frame and a pair of grab hooks mounted on opposite sides of the frame. Each grab hook comprises a material lifting member mounted on and extending between a pair of arms. At an upper end of the arms a pivot pin is fixed to a cross member of the frame, so that the grab hook may swing about its pivot. Further, the pivot pin is moveable along a slot in the cross member, allowing for some adjustment of the grab hook.

**[0004]** To avoid instability where a bundle of material cannot be picked up at its centre point, the material handling device further includes stabilising hooks attached by chains to each end of the frame. A bundle of sheet material may therefore be grasped by the device on all four sides. The above-mentioned material handling device relies on a wedge which must be manually placed between sheets in order to split a stack of material into one or more separate sheets. A suitable wedge is described in US 2008/0217843.

**[0005]** It would be desirable to provide a lifting device which addresses issues with known lifting devices and which also provides an improved method of lifting sheet materials and other heavy loads.

### Summary

**[0006]** According to a first embodiment of the present invention, there is provided a lifting device comprising a frame including two frame halves moveable between a retracted position and an extended position; two or more lifting hooks depending from the frame; and an actuator. The frame halves are configured to be moved between the extended position and the retracted position by the actuator.

**[0007]** Each frame half may comprise a cross piece and two side pieces, and may be provided with two lifting hooks, each lifting hook directly attached to a respective side piece.

**[0008]** The frame halves may be connected to each other by one or more adjustable members.

**[0009]** At least one frame half may be provided with one or more compressible members. The one or more compressible members may comprise springs.

**[0010]** The springs may extend as the frame halves move between the retracted position and the extended position.

**[0011]** The springs, when compressed, may bias the frame halves towards the extended position.

**[0012]** Each lifting hook may be formed from a single piece of metal and may be provided with a substantially flat lifting surface. Each lifting hook may be provided with a tapered edge. Each lifting hook may terminate in a substantially flat face.

**[0013]** Each frame half may be provided with one or more slide blocks.

**[0014]** The lifting device may comprise a bridge, said bridge configured to be attachable to at least one of a forklift truck, a crane, a winch. The bridge may comprise a receiving slot configured to receive the slide block.

**[0015]** The receiving slot may have a height greater than that of the slide block.

**[0016]** The lifting device may comprise a positioning plate depending from each frame half. The positioning plate may comprise one or more springs and a stop. The positioning plate may comprise a curved end and an angled portion.

**[0017]** Each frame half may be provided with a positioning plate attached to the cross piece between the two lifting hooks.

**[0018]** The lifting device may comprise one or more selector devices configured to determine a number of sheets to be lifted.

**[0019]** The one or more selector devices may comprise one or more scissor lifts attached to the frame.

**[0020]** The one or more selector devices may be actuated by a further actuator.

**[0021]** The lifting device may comprise a height adjustment module.

**[0022]** The height adjustment module may be operated by one or more motors. The height adjustment module may be configured to vertically position the lifting hooks relative to a load to be lifted.

**[0023]** The actuator may comprise one of hydraulic, electrical or mechanical power. The actuator may be configured to be remotely controlled.

**[0024]** The lifting device may comprise a rail configured to attach the bridge to the frame. The frame may be connected to the bridge by a rotation device configured to rotate the frame through 90 degrees.

**[0025]** The lifting device may comprise an alarm. The lifting hooks may be provided with apertures for receiving a prong of a fork lift truck.

**[0026]** According to a second aspect of the present invention, there is provided a lifting device comprising: two frame halves; two lifting hooks depending from each frame half; a split rail; a bridge configured to be attached to at least one of: a forklift truck, a crane, a winch; wherein the frame halves are suspended from the split rail, and the split rail is mounted on an upper surface of the bridge.

**[0027]** According to a further aspect, a bridge configured for use with the lifting device of the first aspect is provided, said bridge comprising a pair of parallel side beams connected by a plurality of cross beams, the bridge configured to be attachable to the frame of the lifting device and to at least one of a forklift truck, a crane, a winch, or other support equipment.

Brief Description of the Drawings

**[0028]**

Figures 1a and 1b are perspective views of a lifting device according to the present invention;
Figures 1c and 1d are perspective views of the lifting device in an alternative configuration;
Figures 2a and 2b are perspective views of two frame halves of the device of Figure 1;
Figure 3 is a side view of one of the frame halves of Figure 1;
Figures 4a and 4b are end and perspective views of portions of one of the frame halves of Figure 1 respectively;
Figures 5a and 5b are perspective views of a lifting hook of the device of Figure 1;
Figures 5c, 5d and 5e are alternative embodiments of a lifting hook;
Figure 6 is an end perspective view of a portion of the device of Figure 1;
Figure 7a is a perspective view of a bridge;
Figure 7b is a perspective view of the bridge of Figure 7a including a bridge retainer;
Figures 8a, 8b and 8c are perspective views of a lifting device according to the present invention;
Figures 9a and 9b illustrate side views of the lifting device of Figure 8, in a first and a second position respectively;
Figures 10a and 10b are perspective views of an enlarged portion of the lifting device of Figure 8;
Figures 11a and 11b are perspective views of an enlarged portion of the lifting device of Figure 8;
Figures 12a, 12b and 12c are perspective and plan views of enlarged portions of the lifting device of Figure 8;
Figures 13a and Figure 13b are perspective and enlarged perspective views of a sheet selector;
Figure 13c is an end view of a lifting device comprising the sheet selector of Figures 13a and 13b;
Figures 14a and 14b are side views of a lifting device comprising the sheet selector of Figure 13;
Figures 15a and 15b are perspective and side views of a manual stop;
Figure 15c is a side view of the manual stop of Figures 15a and 15b in use with a lifting device;
Figure 16 is a perspective view of a lifting device according to the present invention;
Figures 17a and 17b are perspective and side views respectively of the lifting device of Figure 16;
Figure 18a is a perspective view of a selector device for use with the device of Figure 16;
Figure 18b is a perspective view of a beam holder for use with the device of Figure 16;
Figure 18c is a perspective view of a split beam for use with the device of Figure 16;
Figure 18d is a perspective view of a scissor lift for use with the device of Figure 16;
Figure 19 is a perspective view of an alternative manual stop;
Figures 20a and 20b are perspective views of a lifting device according to the present invention;
Figure 21 is a side view of a lifting device according to the present invention;
Figures 22a to 22f are perspective views of a lifting device according to the present invention;
Figures 23a, 23b and 23c are perspective views of alternative embodiments of the lifting hook of Figure 5a, according to the present invention;
Figures 24a, 24b and 24c are perspective front, perspective rear, and rear views respectively of an alternative embodiment of a lifting hook;
Figures 25a, 25b, 25c, 25d illustrate a centring device for use with embodiments of the lifting device described herein; and
Figures 26a, 26b, 26c, 26d illustrate the centring device of Figure 25a in position on an embodiment of the lifting device.

Detailed Description

**[0029]** Embodiments of a lifting device and its components are described, as illustrated in Figures 1 to 26. The lifting device comprises a frame, the frame comprising two frame halves moveable between a retracted position and an extended position. The lifting device further comprises two or more lifting hooks depending from the frame; and an actuator. The one or more frame halves are configured to be actuated between the extended and retracted positions by the actuator. Accessories for use with embodiments of the lifting devices are described with reference to Figures 15a, 15b and 19. Also disclosed is a bridge configured for use with one or more of the lifting devices described herein.

**[0030]** Figures 1a, 1b, 1c and 1d illustrate embodiments of the lifting device 10, which comprises two pairs of lifting hooks 12 depending from a frame 14a, 14b. The frame 14a, 14b is formed from two substantially identical frame halves 14a, 14b connected together by two telescopic or extendable tubes or beams 15, and an adjustable (i.e. extendable or telescopic) member 16, which in this example comprises a centrally-located cylinder 16. The cylinder 16 and extendable tubes 15 are moveable by an actuator (not shown here) between a first, unextended or retracted position and an extended position.

**[0031]** Figures 1a and 1b illustrate the lifting device 10 in an unextended and an extended position, respectively, with the cylinder 16 attached to the frame halves 14a,

14b in a first position, to accommodate loads of a first width and/or length. Figures 1c and 1d illustrate an alternative configuration of the lifting device 10 in an unextended and an extended position, respectively, with the cylinder 16 attached to the frame halves 14a, 14b in a second position, to accommodate loads of a second, shorter width and/or length.

**[0032]** In this embodiment, the device 10 further comprises a positioning plate 22 depending from each frame half 14a, 14b. The device 10 further comprises a sheet selector 20 for selecting the number of sheet materials to be lifted. In a further embodiment, the device 10 may further comprise a bridge 44, as illustrated in Figure 7a. The lifting device 10 of Figures 1a, 1b and 1c may be particularly suited for lifting and separating sheets of material such as plasterboard, plywood, MDF, acrylic board, laminate, cladding and the like, although other uses and other load types may be envisaged. In order to accommodate such loads, each pair of lifting hooks 12 may be between 90 cm and 120 cm apart. Of course, the device 10 may be configured such that the gap between the lifting hooks is less than 90 cm or greater than 120 cm, depending upon the requirements of the load to be lifted. Standard plasterboard sheets are 120 cm or 90 cm in width, from 240 to 300 cm in length and typically 9 mm, 12.5 mm, or 15 mm thick.

**[0033]** The two frame halves 14a, 14b are illustrated in more detail in Figures 2a, 2b, 3, 4a and 4b. Each frame half 14a, 14b comprises two cross rails 26 attached at each end to a side rail 24. Each side rail 24 is adapted to receive a telescopic or extendable tube 15 and comprises a slide block 30 defining fixing holes for attaching the frame half 14a, 14b to a bridge (as will be described later in more detail) and an attachment 32 for chains and/or straps and/or shackles and the like. The two cross rails 26 are connected by a beam 25 to which the cylinder 16 and a pair of springs 18 are attached via attachment apertures 28a, 34a, 34b.

**[0034]** In an embodiment, the frame 14 may be constructed of steel or other suitable material. The side and cross rails 24, 26 may be attached by welding or by other suitable means. In a further embodiment, not illustrated here, more than one cylinder 16 may be present.

**[0035]** Figure 5a illustrates one of the lifting hooks 12 in more detail. The hook may be formed from a single piece of metal, such as steel. The hook 12 is provided with a flange 36 defining one or more fixing holes 38 for directly attaching or mounting the hook 12 to the respective side piece 24 of the frame 14, via fixings such as bolts or welds. The hook 12 is further provided with a substantially flat lower lifting surface L upon which, in use, the edge of a sheet of material, such as plasterboard, may rest. An edge or tip T of the hook 12 is tapered to facilitate insertion underneath and/or between sheets of material. As shown in the enlarged view of Figure 5b, the tip T of the hook 12 is tapered on both its upper and lower surfaces. In this example, the upper surface Lu of the hook's lifting surface L extends further than the bottom surface $L_B$ of the hook's lifting surface. The angle of taper from the horizontal for the upper surface of the tip T is therefore different to the respective angle for the lower surface of the tip T. This arrangement assists in lifting without damage.

**[0036]** Figures 5c, 5d and 5e illustrate an alternative embodiment of a lifting hook 120, which may be used with any embodiment of the lifting device, or accessories thereof, described herein. Figure 5c illustrates the lifting hook 120 in perspective, while Figure 5d is a side-on view of the lifting hook 120 and Figure 5e illustrates the portion of the lifting hook 120 denoted by reference A in Figure 5d. Figures 5d and 5e also provide exemplary, non-limiting measurements in mm and exemplary, non-limiting angles in degrees. For example, the upper portion of the lifting hook 120 may have a length of approximately 232 mm. In another example, the taper height of the lifting hook 120 may be approximately 6 mm, with a length of 35 mm. The angle of taper may be approximately 10 ° to the horizontal, as shown in Figure 8e. In one example, the lifting hook 120 may terminate in a substantially flat face or edge E. The alternative lifting hook 120 may also comprise the apertures 38a, 38b, 38c illustrated in Figures 23a, 23b and 23c.

**[0037]** Figure 6 illustrates in more detail a positioning plate 22 of the lifting device 10. The device 10 may be provided with two such positioning plates 22, one depending from each of the two frame halves 14a, 14b. The positioning plate 22 is attached or mounted to an upper surface of one of the cross pieces 26, substantially centrally between the two lifting hooks 12, with a gap of around 3 cm on each side. For example, the positioning plate 22 may be slid into hollow pipes or tubes which are welded or otherwise affixed to cross piece 26. The positioning plate 22 may be locked in place by a lock ring on either side, or by other suitable methods.

**[0038]** The positioning plate 22 is provided with a stop 40 and one or more tensioning devices, which in this example comprise tensioning springs 42. The stop 40 comprises a bar which extends axially for a distance that is longer than a distance between the proximal edges of the two lifting hooks 12. The tensioning springs 42 bias the positioning plate 22 towards a first position, in which the stop 40 rests against the two lifting hooks 12. However, the positioning plate may be pushed into a second position in which the stop 40 is spaced outwardly apart from the lifting hooks 12.

**[0039]** Referring back to Figure 3, it can be seen that in the first position, an angled portion A of the positioning plate 22 is positioned such that it will come into contact with a sheet material to be lifted in advance of the lifting hook 12. In use, as the lifting hooks 12 close around the sheet material, the positioning plate 22 will be pushed or rotated back by the sheet material into the second position. The tension in the tensioning spring 42 ensures that the load does not come into contact with the tip T of the lifting hooks 12 as the device 10 is being lowered into position around the load i.e. the sheet material. This ar-

rangement ensures that the sheet material is correctly positioned so that it may be held by the lifting hooks 12. The positioning plate 22 therefore acts as a guide for the sheet material, or other load to be lifted, and avoids damaging the load.

**[0040]** The positioning plate 22 is additionally provided with one or more guiding rollers C which rotate when they come into contact with the sheet material. When the rollers C come into contact with the load, an alert may be activated in order to warn an operator, for example a forklift truck driver, that contact has been made, so that the device 10 can be centrally positioned on the load. Such an alert may be generated through the use of proximity sensors, or the like.

**[0041]** Figure 7a illustrates a bridge 44. The bridge 44 has a ladder-type construction and may be used to attach the lifting device to, for example, a forklift truck, crane, winch or other conventional lifting device or other support equipment. In one, non-limiting example, the bridge may comprise two (i.e. a pair of) longitudinal side beams 44a, connected in parallel to one another by six, shorter cross beams 44b. In alternative examples, the plurality of cross beams may number approximately between 2 and 10. The bridge 44 is designed to be versatile and to enable a range of different fixing methods. For example, the bridge 44 may be attached directly to the frame 14a, 14b of the lifting device 10, as discussed below, or it may attach indirectly via chains and/or straps, for example, using the attachments 32 provided in the side pieces 24. The bridge 44 may be attached directly or indirectly to a conventional lifting device. For example, the bridge 44 may be provided with fixing holes to be used with straps, chains or ropes. Alternatively or additionally, the side beams of the bridge 44 may have hollow sections into which the forks of a forklift truck, for example, may be inserted.

**[0042]** Figure 7b illustrates the bridge 44 with a bridge retainer 46, designed to attach the bridge 44 to the lifting device. The bridge retainer 46 may be welded to the bridge 44 or affixed to the bridge 44 by other suitable means. In this illustrated example, the bridge retainer 46 comprises two rails configured to attach to the sides of the bridge 44.

**[0043]** As shown in Figures 8a, 8b, 8c, 9a, 9b, 10a, 10b, 11a and 11b, embodiments of the lifting device may comprise the bridge of Figures 7a and 7b. Figures 8a, 8b and 8c illustrate a lifting device comprising the bridge in various extended and unextended positions. Some features of the embodiment shown in Figures 8 to 11 are substantially the same as those of the embodiment shown in Figure 1, and for simplicity, these features will not be discussed in detail again here.

**[0044]** Referring back to Figures 2a, 2b, 3, 4a and 4b, each side rail 24 of the frame 14a, 14b is provided with a slide block 30 defining fixing holes for attaching or mounting the frame half 14a, 14b to the bridge 44. The bridge retainer 46 is configured to receive the slide blocks 30 of the side rails 24. Each frame half 14a, 14b may be provided with more or less than two slide blocks 30.

**[0045]** Figure 9a illustrates the lifting device 10 and frame 44 with the cylinder 16 in a partially extended position. Typically, the unextended cylinder 16 may be between 20 cm and 50 cm in length. Figure 9b illustrates the lifting device 10 and frame 44 with the cylinder 16 and telescopic or extendable tubes 15 in a second, expanded position. It will be appreciated that expansion of the cylinder 16 into the second, expanded position may be carried out by an actuator (not shown), as will be discussed further below. In the second, expanded position, the two frame halves 14a, 14b, which are connected together by the telescopic or extendable tubes 15, cylinder 16 and springs 18, are pushed further apart from one another.

**[0046]** As best illustrated in Figures 9a and 9b, when the cylinder 16 moves towards the second, expanded position, each slide block 30 slides along a receiving slot 45 of the bridge retainer 46. This enables the two half frames 14a, 14b, and therefore the lift hooks 12, to move relative to the bridge 44. In other words, actuation of the cylinder 16 into an extended position opens the lifting device 10 into an expanded position so that the device 10 can be lowered around a sheet or stack of sheets to be lifted. It will be appreciated that the receiving slot 45 of the bridge retainer 46 also provides a stop function for the slide blocks 30.

**[0047]** Figures 10a, 10b, 11a and 11b illustrate a slide block 30 and the receiving slots 45 of the bridge retainer 46 in more detail. The receiving slots 45 are attached to the bridge retainer 46 by a hinge 48 such that they may be rotated upwardly in order to release the slide blocks 30 and remove the lifting device 10 from the bridge 44. As shown in Figure 10a, a minimum height of the receiving slots 45 may be greater than a maximum height of the slide block 30, such that there is provided a gap G between the upper surface of the slide block 30 and an underside of the upper surface of the receiving slot 45. The gap G may be around 2 to 3 cm in height, preferably 2.5 cm in height. This gap G ensures that the weight of the bridge does not rest upon the materials or load to be lifted by the lifting device 10. Each end of the bridge retainer 46 may comprise one or more retaining slots 45.

**[0048]** Figures 12a, 12b and 12c illustrate the cylinder 16 and associated springs 18 in more detail. The cylinder 16 is shown attached to attachment apertures 28a in the first position, as illustrated in Figures 1a and 1b. Figure 12c illustrates the second attachment aperture 28' to which the cylinder 16 may be attached in the second position (the alternate configuration shown in Figures 1c and 1d). An actuator (not shown) may utilise hydraulic, electrical or mechanical power to extend and to retract the cylinder 16. In use, the cylinder 16 may be extended and retracted fully or partially by the actuator. In a further embodiment, not shown here, where two cylinders 16 are present the actuator acts on each cylinder 16 equally such that they move simultaneously. The actuator may be operated to expand the cylinder 16 to a point where

the lifting hooks 12 are adjusted to provide a sufficient clearance around the load to be lifted. It will be appreciated that, in use, as the cylinder 16 is actuated by the actuator towards its original, unextended position, the telescopic or extendable tubes 15 are similarly pulled towards their unextended position.

**[0049]** As best illustrated in Figure 12c, the beam 25 to which the cylinder 16 and springs 18 are attached is formed in two parts 28b, 28c. The first part 28b, to which the cylinder 16 is attached via aperture 28a or 28', is slideably disposed within the second part 28c. One end of the spring 18 is attached to the first part 28b via aperture 34a, while the other end of the spring 18 is attached to the second part 28c via aperture 34b. The first part 28b moves within the second part 28c as the cylinder 16 extends, thus stretching the spring 18.

**[0050]** The beam 25 may only need to be slideable on one side of the cylinder 16 i.e. on one of the frames halves 14a, 14b. The beam 25 on the opposing side of the device 10 may be permanently attached, for example by welding or by a bolt.

**[0051]** The springs 18 are used to prevent the load from being damaged if the lifting hooks 12 do not contact the load at the correct point. In other words, the compressive force of each spring 18 absorbs at least a portion of the force supplied by the actuator if the device 10 begins to close too far/further than expected. Each spring 16 may provide a force of around 100 kg on the tip T of the lifting hooks 12. In the case of the lifting hooks 12 contacting the load at an incorrect point (i.e. a "bad hit" occurs), the springs 18 may be used to trigger a visual or audible alert to warn an operator of this fact. An alarm may also be triggered if the spring 18 stretches further than expected. Additionally, the springs 18 may be used to retain pressure on the load by providing a biasing force to the device as the load is lifted.

**[0052]** In this illustrated embodiment, two springs 18 are used for each cylinder 16. In an alternative embodiment, not shown here, more than two springs may be with each telescopic member or cylinder; for example, four springs may be used, two on each side of the cylinder. As the cylinder 16 is retracted towards the unextended position, the two frame halves 14a, 14b are pulled closer to each other and the lifting hooks 12 mounted on the frame halves 14a, 14b close around and grip/support the sheet or sheets to be lifted. Of course, depending upon the length and/or width of the sheet material being lifted, the cylinder 16, and extendable tubes 15 may not retract fully into the retracted position.

**[0053]** The use of springs 18 in the lifting device 10 minimises damage, such as chipping, bending, splitting, to the material to be lifted. The positioning plates 22 ensure that the sheets are guided into the correct position on the lifting hooks 12 as the device 10 closes/retracts.

**[0054]** In order to release the load, the cylinder 16 is again actuated into an extended position such that the lifting hooks 12 move apart and away from the load.

**[0055]** Embodiments of the lifting device 10 comprise a sheet selector 20. Figures 13a and 13b illustrate the sheet selector 20 in more detail; Figure 13c illustrates the sheet selector 20 in use with an embodiment of the lifting device 10. The sheet selector 20 comprises a telescopic or extendable beam 50 and two height adjustment modules 52. As best illustrated in Figure 13b, at least one of the height adjustment modules 52 comprises a stepper motor 56 connected to a lead screw 54. The motors 56 and lead screws 54 work together to raise or lower the height of the telescopic or extendable beam 50, which is also moveable between an expanded and a contracted position.

**[0056]** In the illustrated embodiment, the height adjustment modules 52 of the sheet selector 20 are attached to the lifting device 10 by welding to the back of the lifting plates 12. Other suitable methods of attachment may be envisaged. In the illustrated embodiment, there is a selector device 20 on each side of the device 10, therefore there are at least two and may be four stepper motors 56 in total.

**[0057]** Figures 14a and 14b illustrate the sheet selector 20 in use. In Figure 14a, the beam 50 is resting on the top of a stack of sheet materials S. The lifting device 10 is actuated to be in the extended position such that the cylinder 16 and telescopic or extendable tubes 15, are extended and there is a clearance between the sheet material stack S and the lifting hooks 12. In order to select the number of sheets to be gripped/lifted, the stepper motor 56 is operated together in order to raise or lower the beam 50, thus moving the lifting device 10 and the lifting hooks 12, to which the sheet selector 20 is attached, vertically up or down. As shown in Figure 14b, once the desired height has been achieved, the actuator is operated to retract the lifting device 10 and the cylinder 16 and tubes as far as possible to the unextended position. The beam 50 of the sheet selector 20 is similarly retracted.

**[0058]** At this point the lifting hooks 12 are inserted between the desired sheets and are separating the stack S such that the required number of sheets is lifted. It will be noted that the positioning plate 22 is biased by contact with the remaining sheets of the stack S into an outward position.

**[0059]** The sheet selector 20 makes it easy to select the correct number of sheets from a stack, and provides a very precise placement of the lifting hooks 12. In a further embodiment not shown here, the sheet selector 20 may be operated by remote control to select a desired number of sheets from a stack of sheets.

**[0060]** Figures 15a and 15b illustrate an accessory 60 which may be used with the lifting device 10 alternatively or additionally to the sheet selector 20 described above. The accessory 60 comprises a manual stop 60 which is manually placed onto a long edge of a sheet material at a central position, below the sheets which it is desired to lift. Typically, a pair of manual stops 60 is used, and one stop 60 is inserted on each side of the sheet. In one embodiment, the manual stop 60 may be formed of 1 mm

thick galvanised steel and may be around 1 m in length. Once mounted, the manual stop 60 protrudes slightly from the edge of the sheet material and withstands the load exerted by the lifting hooks of the lifting device. Figure 15c illustrates pair of stops 60 in use with a stack of sheet material S.

**[0061]** Figure 16 illustrates an embodiment of a lifting device 100. The lifting device has many features in common with the lifting device 10 described above and comprises two pairs of lifting hooks 112 depending from a frame 114a, 114b. The lifting hooks 112 may be around 10 cm wide. The frame 114a, 114b is formed from two substantially identical frame halves 114a, 114b connected together by two telescopic or extendable tubes or beams 115, and an adjustable (i.e. extendable or telescopic) member 116, which in this example comprises a centrally-located cylinder 116. Four biasing members 118 (e.g. springs) are associated with the cylinder 116 on one of the frame halves 114b. The springs 118 determine the amount of force used in the device's 100 grip and operate in substantially the same way as the springs 18 discussed above. The cylinder 116 and extendable tubes 115 are moveable by an actuator (not shown here) between a first, unextended or retracted position and an extended position, as shown in Figure 16. The lifting device 100 may be particularly suited for lifting and separating sheets of material such as steel reinforcing mesh or mats, although other uses and other load types may be envisaged.

**[0062]** The two frame halves 114a, 114b, lifting hooks 112, adjustable members 115, cylinder 116 and associated springs 118 are substantially similar to those features described with reference to Figures 1 to 14, and operate in substantially the same way, so will not be discussed again here. However, it will be appreciated that where the material to be lifted comprises an open mesh, for example, rather than gripping the edges of the material one pair of lifting hooks 112 may instead be inserted into the open mesh. In this way, materials such as reinforcement mats may also be lifted in a substantially vertical or angled position.

**[0063]** In one embodiment, the device 100 further comprises a pair of selector devices 120 attached or mounted respectively to the frame halves 114a, 114b adjacent the lifting hooks 112. For example, each of the selector devices 120 may be welded to the frame halves 114a, 144b. The selector devices 120 enable a number of sheets or units of material to be selected, and will be described in more detail below.

**[0064]** As shown in Figure 17a, embodiments of the lifting device 100 may comprise a bridge 144 and a split rail 162, which is illustrated in more detail in Figure 18c. The bridge 144 may be substantially similar to the bridge 44 described with reference to Figure 7 above. As illustrated in Figure 18c, the rail 162 comprises fixing apertures which enable it to be attached or mounted to an upper surface of the bridge 144, for example, by screws, bolts, welds or the like. Alternatively or additionally, the rail 162 may comprise a socket which engages with a portion of the bridge 144. The lifting device 100 may be attached to, i.e. suspended from, the rail 162 via chains, straps, shackles, or other suitable attachments. The use of a split rail 162 and bridge 144 with the lifting device 100 reduces the height required for handling materials such as reinforcement mats.

**[0065]** Figure 18a illustrates a selector device 120 in more detail. The selector device 120 comprises a beam 150, an expandable tube or cylinder 152, and a pivot assembly 154. In use, the pair of selector devices 120 operate in a similar fashion to the sheet selector 20 described above, in that they raise or lower the height at which the lifting hooks 112 are inserted into a stack, in order to select a desired number of sheets for lifting.

**[0066]** The selector device 120 is designed to select a number of sheets by lifting in the centre of a load, such as reinforcement mesh. A beam 150 is made to slide up and down between the lifting hooks 112 to select the number of sheets to be lifted. The cylinders 152 on both sides of the lifting device 110 cooperate in determining the distance between the tip T of the lifting hooks 112, and the underside of the beam 150. The selector device 120 may be actuated by hydraulic, electric or mechanical means, or may be manually operated.

**[0067]** As illustrated in Figure 18b, embodiments of the lifting device 100 may also include one or more beam holders 156. The beam holders 156 may be attached to the device 110 by bolts, welding or the like and are configured to support beam 162 when standing by. When the beam 162 is attached to the bridge 144, the other end of bridge 144 can then rest on a suitable table, set of feet etc.

**[0068]** Alternatively or additionally to the selector device 120 illustrated in Figure 18a, the lifting device 100 may comprise one or more scissor lifts 121, as illustrated in Figure 18d. The scissor lifts 121 may be attached to the frame of the lifting device 100 by welding, by bolts or by other suitable means, and enable to selection of a number of sheets from a stack of sheets. Where scissor lifts 121 are used as an alternative to the selector device 120, the lifting device 100 may further comprise positioning plates between the lifting hooks 112, as described above.

**[0069]** Figure 19 illustrates an accessory 160 which may be used with the lifting device 100 alternatively or additionally to the selector device 120 or scissor lifts 121 described above. The accessory 160 comprises a manual stop 160 which is manually placed under a long edge of a sheet material, such as a wire reinforcement mat, below the sheets which it is desired to lift. Typically, two pairs of manual stops 160 may be used, and two stops 160 are inserted on each side of the sheet or mat. The stop 160 then rests on the sheet e.g. plasterboard.

**[0070]** Figures 20a and 20b illustrate an embodiment of a lifting device 200. The lifting device has some features in common with the lifting devices 10 and 100 described above and comprises two pairs of lifting hooks

212 depending from two substantially identical frame halves 214a, 214b. The lifting device 200 may be particularly suited for lifting and separating sheets of material such as steel reinforcing mesh or mats, although other uses and other load types may be envisaged.

**[0071]** The lifting device 200 further comprises a split rail 262 and a bridge 244. The rail is substantially the same as the rail 162 discussed with reference to Figure 17b and will not be discussed in detail here. The bridge 244 is substantially the same as the bridge discussed with reference to Figure 7, and similarly will not be discussed in detail here.

**[0072]** The frame halves 214a, 214b are not directly connected to each other but are instead attached to the rail 262, which is itself attached to a top surface of the bridge 244. The frame halves 214a, 214b may be suspended from the rail via attachment apertures using chains, straps, shackles or the like. The bridge 244 may be further attached to a known lifting device, such as a crane or forklift truck. The use of a split rail 262 mounted on top of the bridge 244 reduces the height required to handle materials such as reinforcement mats, which can be lifted by hooking the lifting hooks 212 through the wire mesh and pulling the chains attaching the frame halves 214a, 214b to the rail 262. In one embodiment, the lifting hook 212 width is customised to fit standard dimensions on reinforcement mats.

**[0073]** In the device shown in Figure 20b, each frame half 214a, 214b is further attached to the split rail 262 by a spring 218. The springs 218 bias the lifting hooks 212 into a position, for example, around 10 to 15 cm above the lower end of the chains/straps/shackles, such that the chains/straps/shackles are slack. When pulling the hooks 212 down into a desired position for lifting, the biasing force of the springs 218 will keep the hooks 212 in the desired position.

**[0074]** Figure 21 illustrates an embodiment of a lifting device 300. The lifting device has some features in common with the lifting devices 10, 100 and 200 described above and comprises a pair of lifting hooks 312 depending from two substantially identical frame halves 314a, 314b. The lifting device 300 may be particularly suited for lifting and separating sheets of material such as plasterboards, steel reinforcing mesh or mats, although other uses and other load types may be envisaged. In particular, the device 300 comprises a tilt function which enables horizontal to vertical positioning of sheet materials.

**[0075]** The lifting device 300 may further comprise a bridge 344. The bridge 344 is substantially the same as the bridge 44 discussed with reference to Figure 7, and similarly will not be discussed in detail here.

**[0076]** Figures 22a to 22f illustrate an embodiment of a lifting device 400. The lifting device has some features in common with the lifting devices 10, 100, 200 and 300 described above and comprises two pairs of lifting hooks 412 depending from two substantially identical frame halves. The device 400 is mounted on a bridge 444, similar to the bridges described above, via a rotation device 420, which is shown in greater detail in Figure 22b. The lifting device 400 may be particularly suited for lifting and separating sheets of material such as plasterboards, steel reinforcing mesh or mats, although other uses and other load types may be envisaged.

**[0077]** The device 400 makes possible lifting of sheet material, such as plaster-boards, from ground level to a chosen level. The device 400 is particularly useful when the width and height of the opening are not suitable for traditional approaches. A given number (1 to 22) of plaster-boards could be picked up from a horizontal stack on ground level. The device 400 is rotatable so that the boards can be lifted to an almost vertical angle, as illustrated in Figures 22c and 22d. The device 400 is also configured to rotate through 90 degrees, as illustrated in Figures 22e and 22d.

**[0078]** Figures 23a, 23b and 23c are alternative embodiments of the lifting hook 12 of Figure 5a. These alternative hooks 12a, 12b, 12c may be used on their own, as well as with any of the devices described herein. Some of the features of the lifting hooks 12a, 12b, and 12c are the same as those described with reference to Figure 5a, so will not be described in detail again here. One difference between the lifting hook 12 of Figure 5a and the alternative lifting hooks 12a, 12b, 12c is that the alternative lifting hooks 12a, 12b, 12c include apertures 38a, 38b, 38c for insertion of a fork of a fork lift truck, or the like. The hooks 12a, 12b, 12c enable lifting of one side of a given number of boards from a stack, making space for a wedge, or similar.

**[0079]** Figures 24a, 24b and 24c illustrate a further alternative lifting hook 12d, adapted for use with a linear jack 62 as the lifting source. The lifting hook 12d is mounted under the chosen amount of sheets to be lifted, substantially in the middle of the long side of the stack. The hook 12d is then tapped in with a rubber hammer. The jack 62 is then mounted at a suitable height under a mounting-bracket M along the back of the lifting hook 12d. The jack then lifts the hook 12d and the sheets, for example, by around 10 cm. The forks of a fork lift truck then have sufficient space for insertion under the desired number of sheets. The sheets may be lifted while the hook 12d and the jack 62 are left behind. The jack 62 can be operated manually or using an electrical engine.

**[0080]** It will be appreciated by the person skilled in the art that various modifications may be made to the above described embodiment, without departing from the scope of the present invention. For example, in one embodiment the number of lifting hooks provided may be more or less than four. Similarly, in one embodiment more or less than two telescopic members, such as cylinders, may be provided; in one embodiment more or less than two springs per telescopic member may be provided. The members may be telescopic or may be configured to expand and retract in alternative ways. The same applies to the telescopic or extendable tubes 15 and the beam 25 of the selector 20.

**[0081]** Figures 25a, 25b, 25c, 25d illustrate a centring

device 63 for use with embodiments of the lifting device described herein. In particular, the centring device 63 may be used when the lifting device is supported by a crane. The centring device 63 comprises two longitudinal beams 65 connected to two cross beams 64. In this example, the centring device further comprises segments 66, which enable the centring device 63 to be slideably connected to the lifting device. Figure 25a illustrates a perspective view of the centring device 63 and Figure 25b illustrates a plan view. Figures 25c and 25d respectively illustrate end on and side on view of the centring device 63 which include exemplary, non-limiting dimensions in millimetres.

**[0082]** For example, as shown in Figure 25c, in a non-limiting example, the centring device may be approximately 120mm in height, including the segments 66, and may be approximately 550 mm wide. As shown in Figure 25d, the centring device 63 may be approximately 1340 mm long, and the cross beams 64 may be located approximately 10 mm in from the end of the longitudinal beams 65. The segments 66 may be located approximately 200 mm in from the end of the longitudinal beams 65, and may be located 700 mm apart from one another. Figures 26a (perspective view), 26b (end view), 26c (side view), 26d (plan view) illustrate the centring device 63 of Figure 25a in position on an embodiment of the lifting device, for example, the lifting device shown in Figure 1a. In this illustrated example, the centring device 63 is provided with a set of wheels 67 at one end.

**[0083]** The purpose of the centring device 63 is to keep the lifting device centred as it moves up and down, as well as when the grip is opened and closed. For example, when opening the grip of the lifting device it may be difficult to predict the direction in which the device will initially open. The centring device 63 locks the lifting device on one side. In other words, the centring device 63 prevents any skewing of the lifting device from a central position over the materials to be lifted. Where present, the wheels 67 of the centring device 63 may be brought into contact with a wall, or other surface. Alternatively, the wheels 67 shown in Figures 26a to 26d may be replaced by a pulley and rail solution on one side. This locks movement in two directions or more.

**[0084]** Although the embodiments described herein may be particularly useful for lifting sheet materials such as plasterboard and concrete reinforcing mesh, the lifting devices of the present invention are not limited to this use and may be used for lifting many different types, sizes and shapes of load, such as tanks, stone, pallets and so forth. The lifting hooks may be used for inserting into mesh or for providing a flat support surface.

**[0085]** In one embodiment a control device is provided which is linked to a scissor lift/selector device and which enables an operator to select a number of sheets or units in a stack to be lifted. For example, the control device may be configured to operate the lifting device with three different thicknesses of board, the-desired number of board to be lifted (which may be selected by display) and/or the size of boards or units to be lifted (e.g. 90 or 120 cm).

**[0086]** In one embodiment one or more power sources are provided for the telescopic member actuator or actuators, and/or for other actuatable components. In one embodiment, the power source(s) may be remotely controlled. The device may therefore include one or more remote control units with appropriate features. Suitable engines may be used for actuation of the various components (e.g. cylinders, selector devices, sheet selector, scissor lifts). Such engines may include stepper motors / servo stepper motors and the like. Engine units may be pre-programmed and may include necessary accessories. Engine operation may be speed-adjusted.

**[0087]** It will be appreciated that the lifting devices described herein may be assembled in different ways into a modular lifting system having different combinations of bridges, rails, positioning plates, selector devices, scissor lifts and the like, depending upon the specific requirements of the load to be lifted. Features, components, accessories and modules of the various embodiments described herein may therefore be combined and adjusted as needed.

## Claims

**1.** A lifting device, comprising:

a frame including two frame halves moveable between a retracted position and an extended position;
two or more lifting hooks depending from the frame; and
an actuator;
wherein the frame halves are configured to be moved between the extended position and the retracted position by the actuator.

**2.** A lifting device as claimed in claim 1, wherein each frame half comprises a cross piece and two side pieces, and is provided with two lifting hooks, each lifting hook directly attached to a respective side piece.

**3.** A lifting device as claimed in claim 1 or 2, wherein the frame halves are connected to each other by one or more adjustable members, and optionally wherein at least one frame half is provided with one or more compressible members; wherein the one or more compressible members optionally comprise springs.

**4.** A lifting device as claimed in claim 3, wherein the springs extend as the frame halves move to the extended position, and optionally wherein the springs, when compressed, bias the frame halves towards the extended position.

**5.** A lifting device as claimed in any preceding claim,

wherein each lifting hook is formed from a single piece of metal and is provided with a substantially flat lifting surface, and/or wherein the lifting hooks are provided with apertures for receiving a prong of a fork lift truck.

**6.** A lifting device as claimed in any preceding claim, wherein each lifting hook is provided with a tapered edge, and wherein optionally each lifting hook terminates in a substantially flat face.

**7.** A lifting device as claimed in any preceding claim, wherein each frame half is provided with one or more slide blocks, and/or wherein the bridge comprises a receiving slot configured to receive the slide block, and optionally wherein the receiving slot has a height greater than that of the slide block.

**8.** A lifting device as claimed in any preceding claim, comprising a bridge, said bridge configured to be attachable to at least one of a forklift truck, a crane, a winch, and/or comprising a rail configured to attach to the bridge to the frame, wherein the frame is optionally connected to the bridge by a rotation device configured to rotate the frame through 90 degrees.

**9.** A lifting device as claimed any of claims 2 to 8, comprising a positioning plate depending from each frame half, wherein each positioning plate is attached to the cross piece between the two lifting hooks, and wherein the positioning plate optionally comprises one or more springs and a stop, and/or a curved end and an angled portion.

**10.** A lifting device as claimed in any preceding claim, comprising one or more selector devices configured to determine a number of sheets to be lifted, wherein the one or more selector devices optionally comprise one or more scissor lifts attached to the frame, and/or wherein the one or more selector devices are actuated by a further actuator.

**11.** A lifting device as claimed in any preceding claim, comprising a height adjustment module, wherein the height adjustment module is optionally operated by one or more motors, and/or wherein the height adjustment module is configured to vertically position the lifting hooks relative to a load to be lifted.

**12.** A lifting device as claimed in any preceding claim, wherein the actuator comprises one of hydraulic, electrical or mechanical power, and is optionally configured to be remotely controlled.

**13.** A lifting device as claimed in claim 3 or claim 9, further comprising an alarm, said alarm connected to said biasing members and/or said positioning plates, said lifting device optionally further comprising a centring device configured to limit movement of the lifting device in one or more directions.

**14.** A lifting device, comprising:

two frame halves;
two lifting hooks depending from each frame half;
a split rail;
a bridge, configured to be attached to at least one of: a forklift truck, a crane, a winch;
wherein the frame halves are suspended from the split rail, and the split rail is mounted on an upper surface of the bridge.

**15.** A bridge configured for use with the lifting device of any of claims 1 to 7 and 9 to 13, said bridge comprising a pair of parallel side beams connected by a plurality of cross beams, the bridge configured to be attachable to the frame of the lifting device and to at least one of a forklift truck, a crane, a winch, or other support equipment.

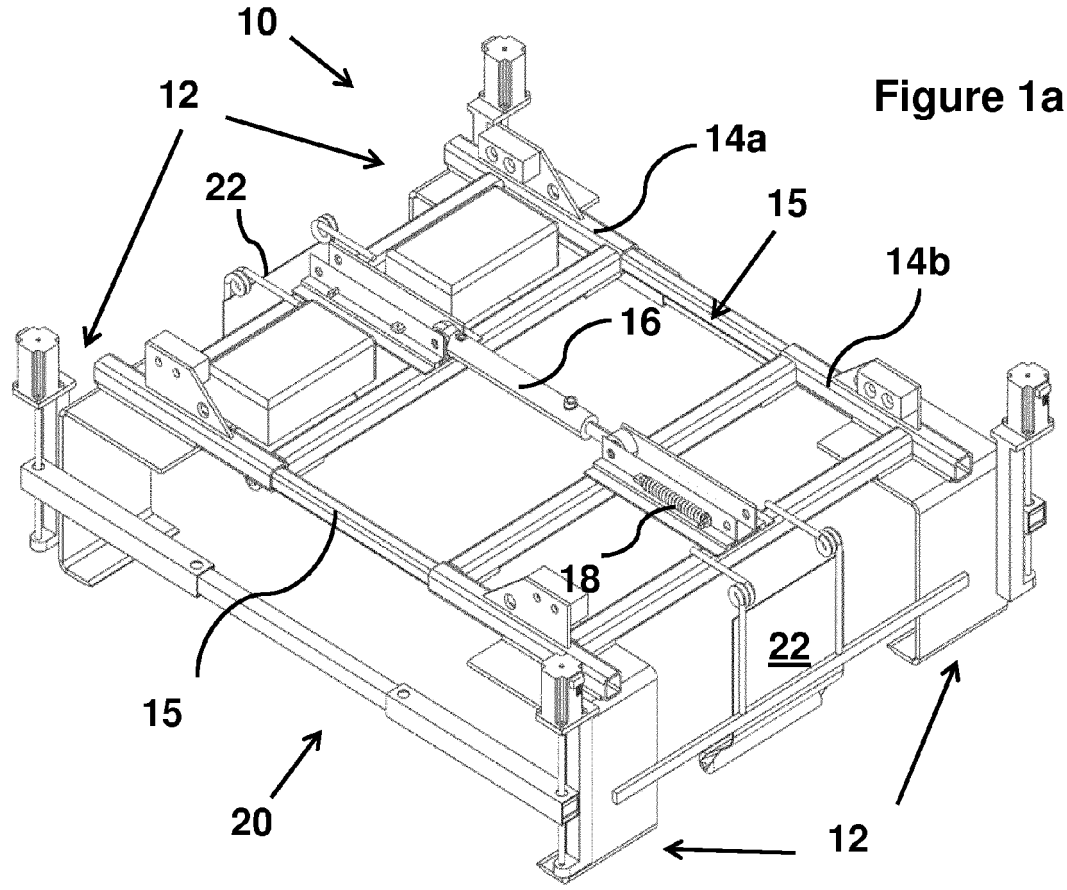



Figure 1a

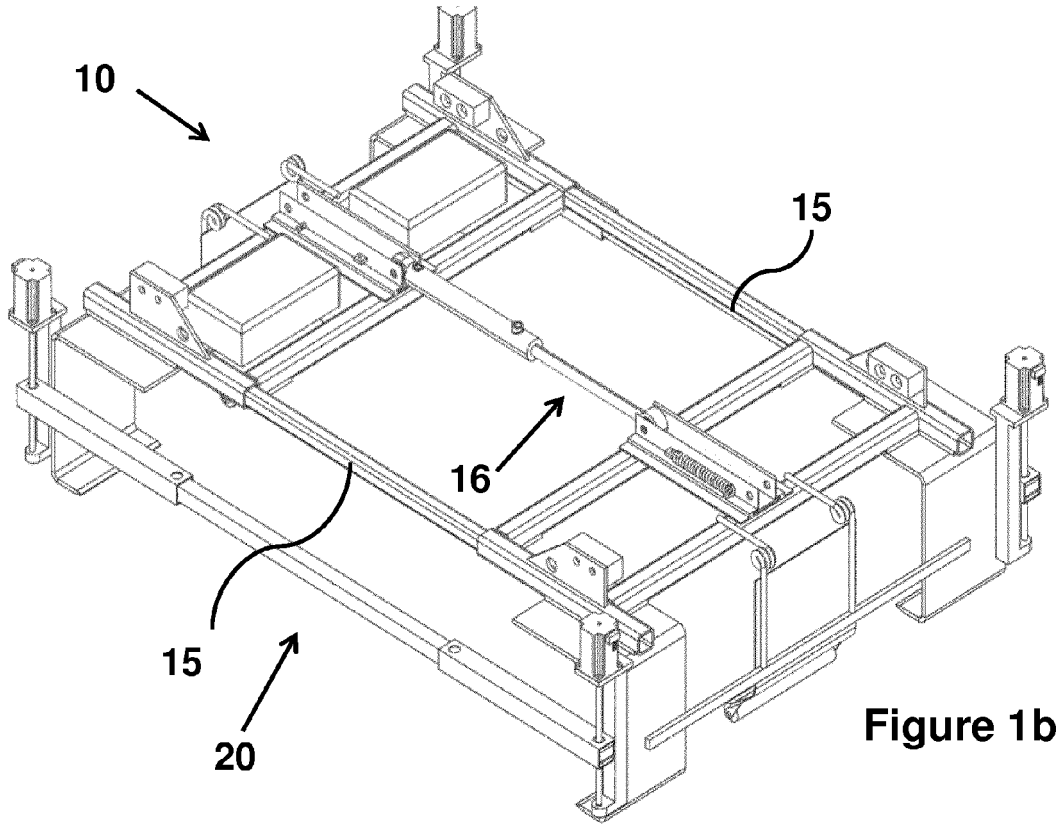



Figure 1b

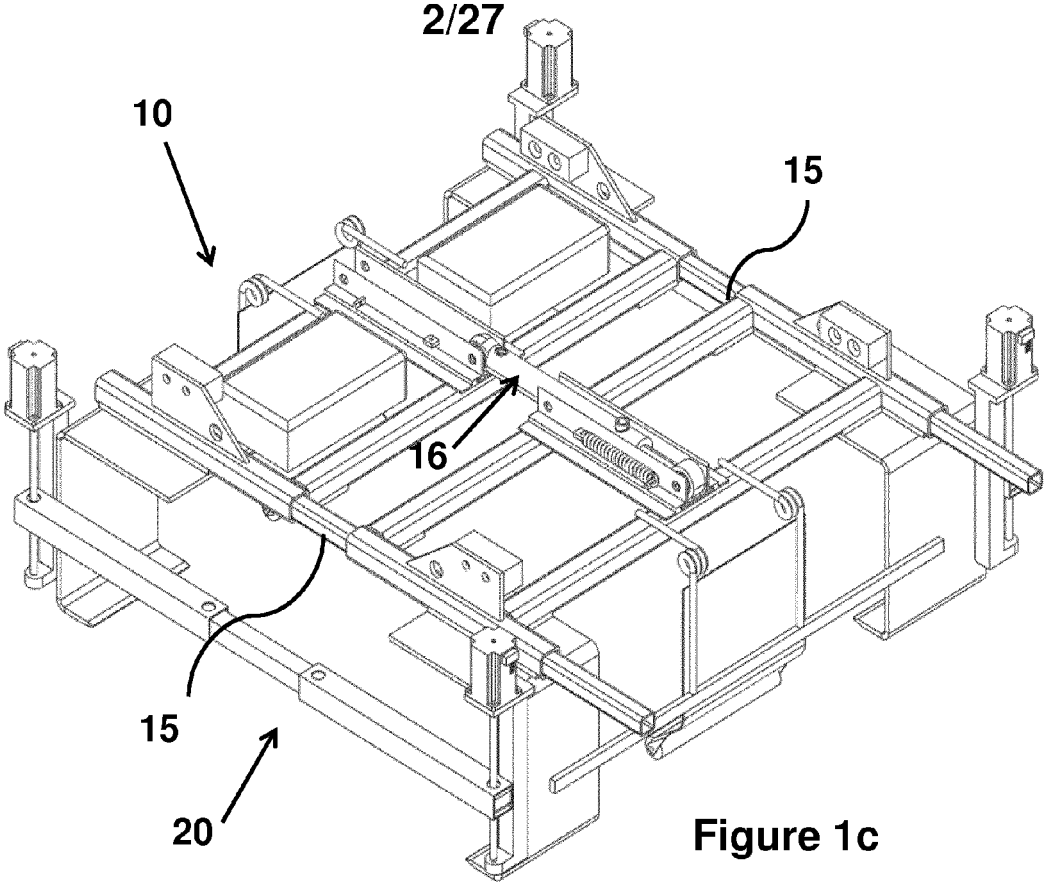



Figure 1c

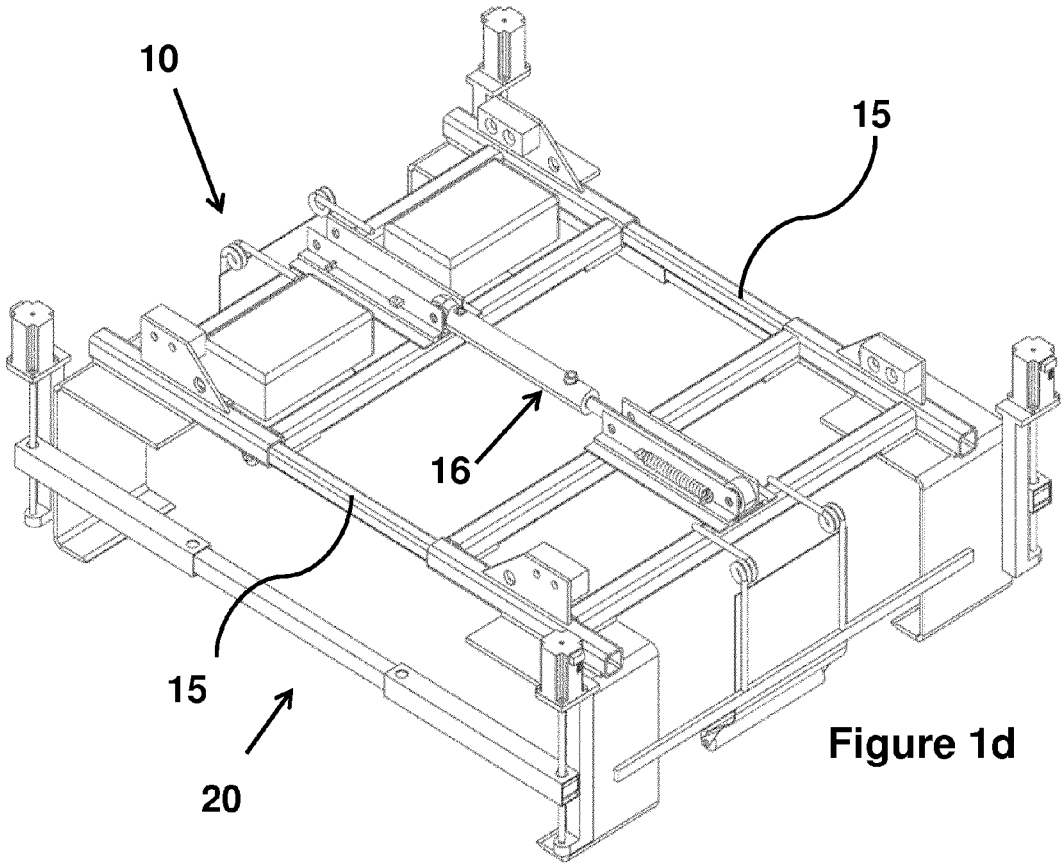



Figure 1d

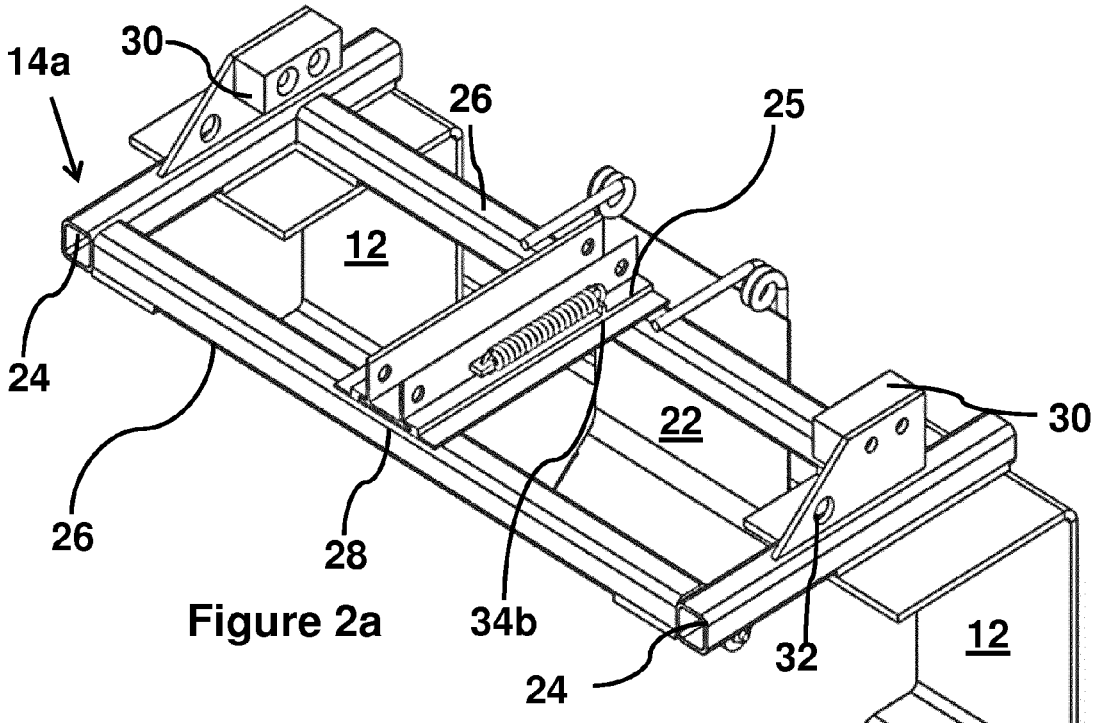



Figure 2a

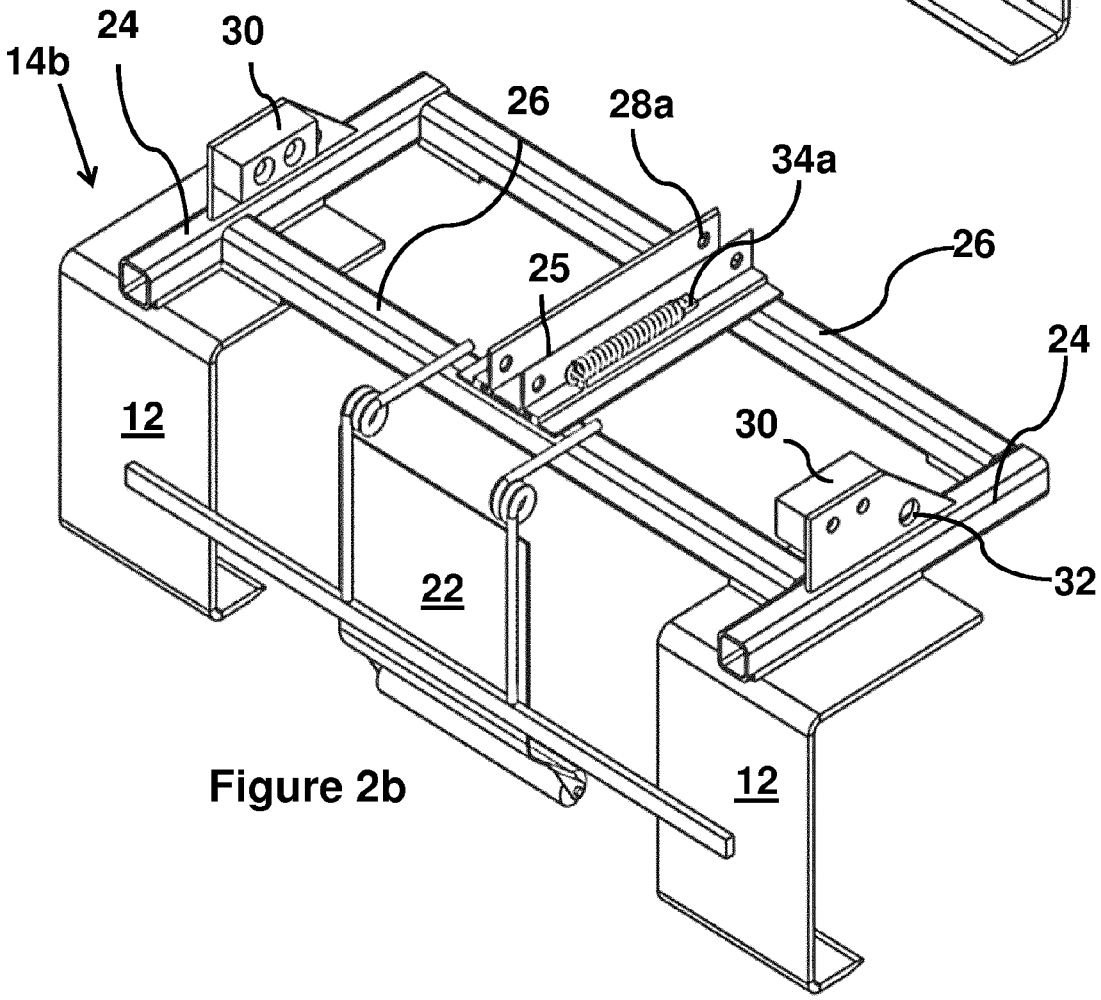



Figure 2b

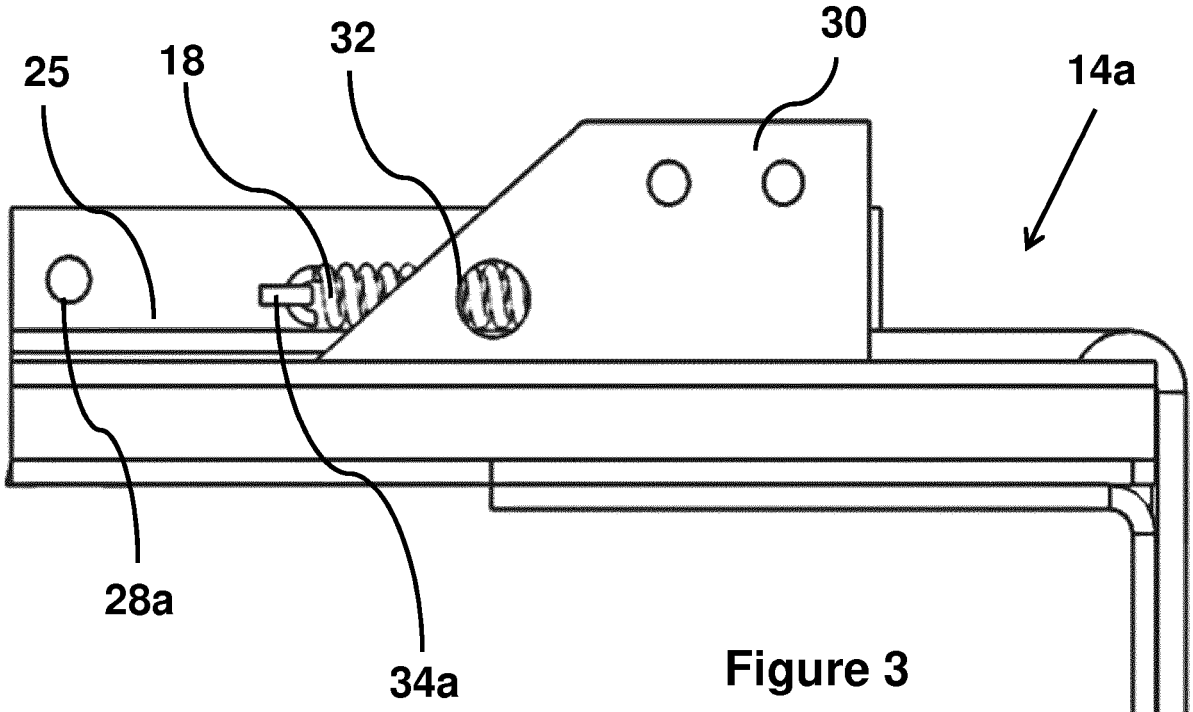



Figure 3

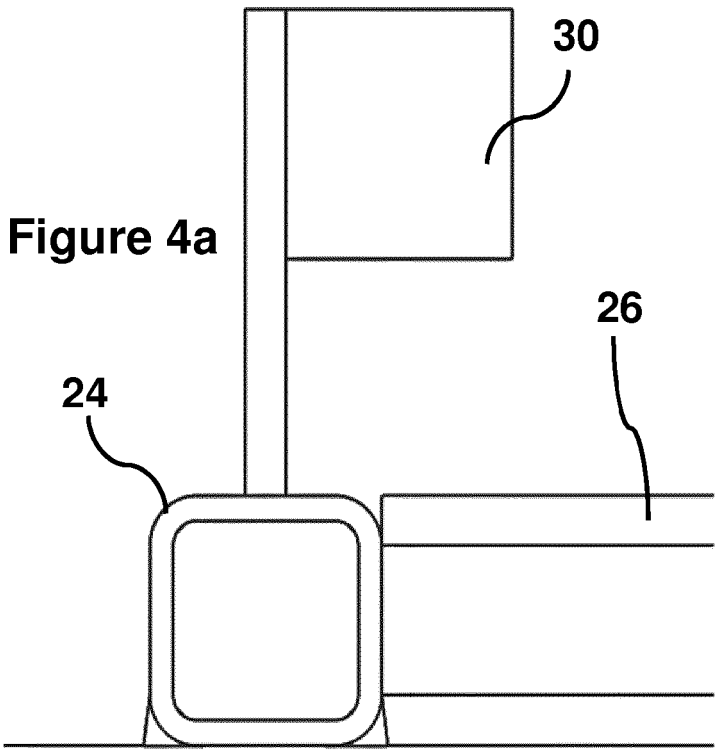
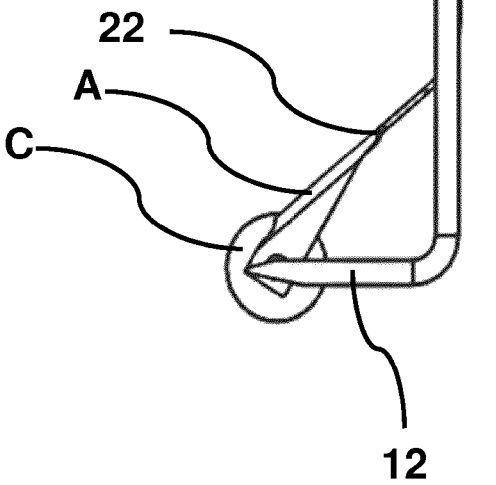



Figure 4a



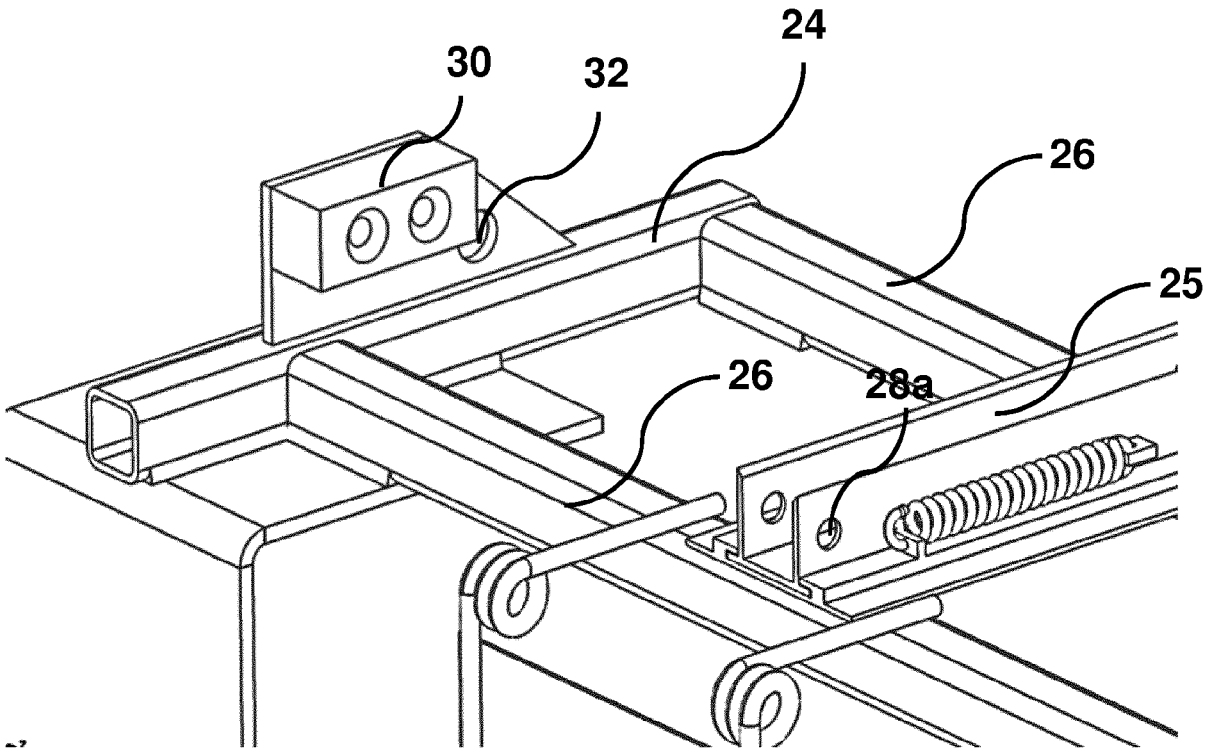



Figure 4b

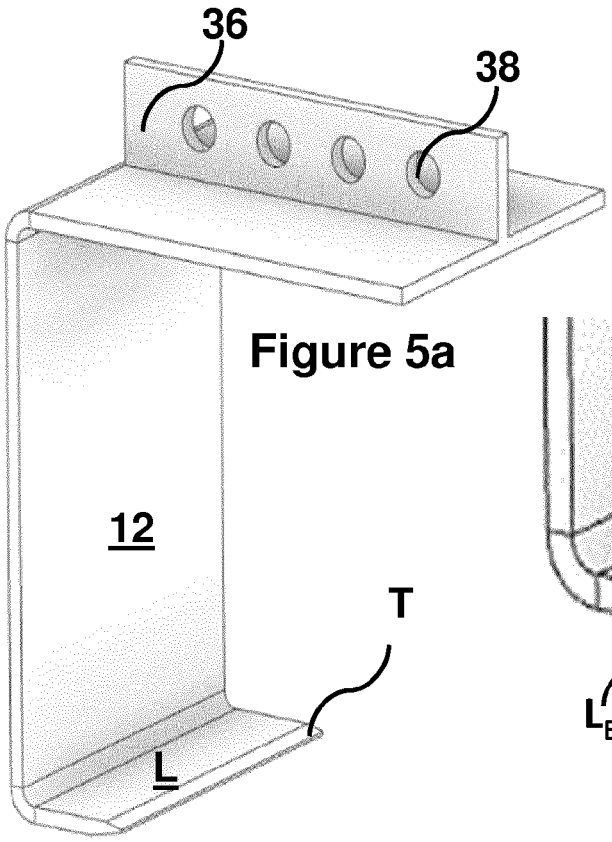



Figure 5a

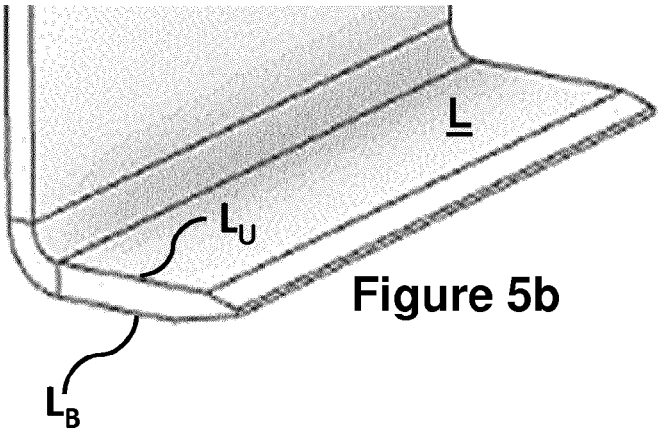



Figure 5b

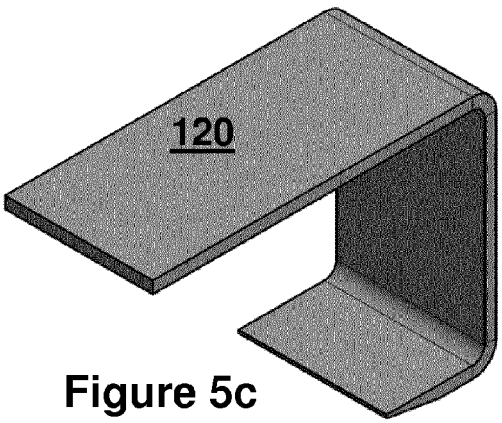



Figure 5c

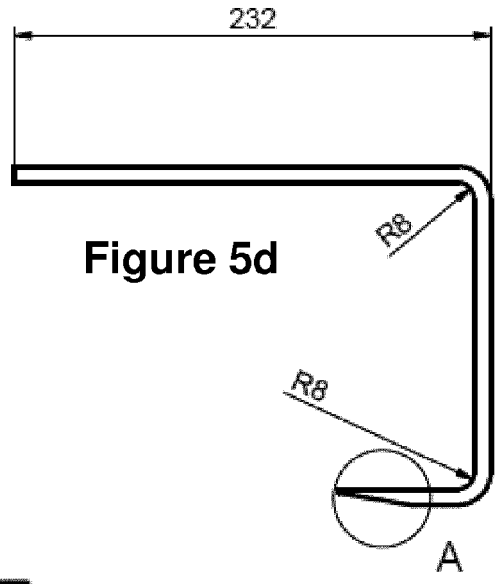



Figure 5d

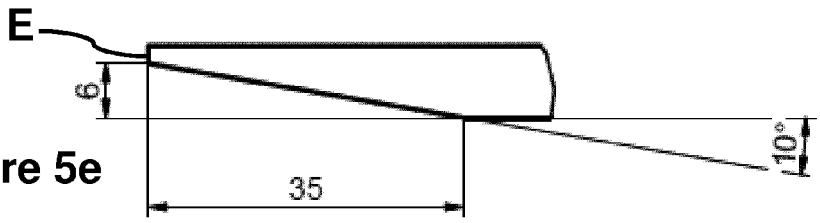



Figure 5e

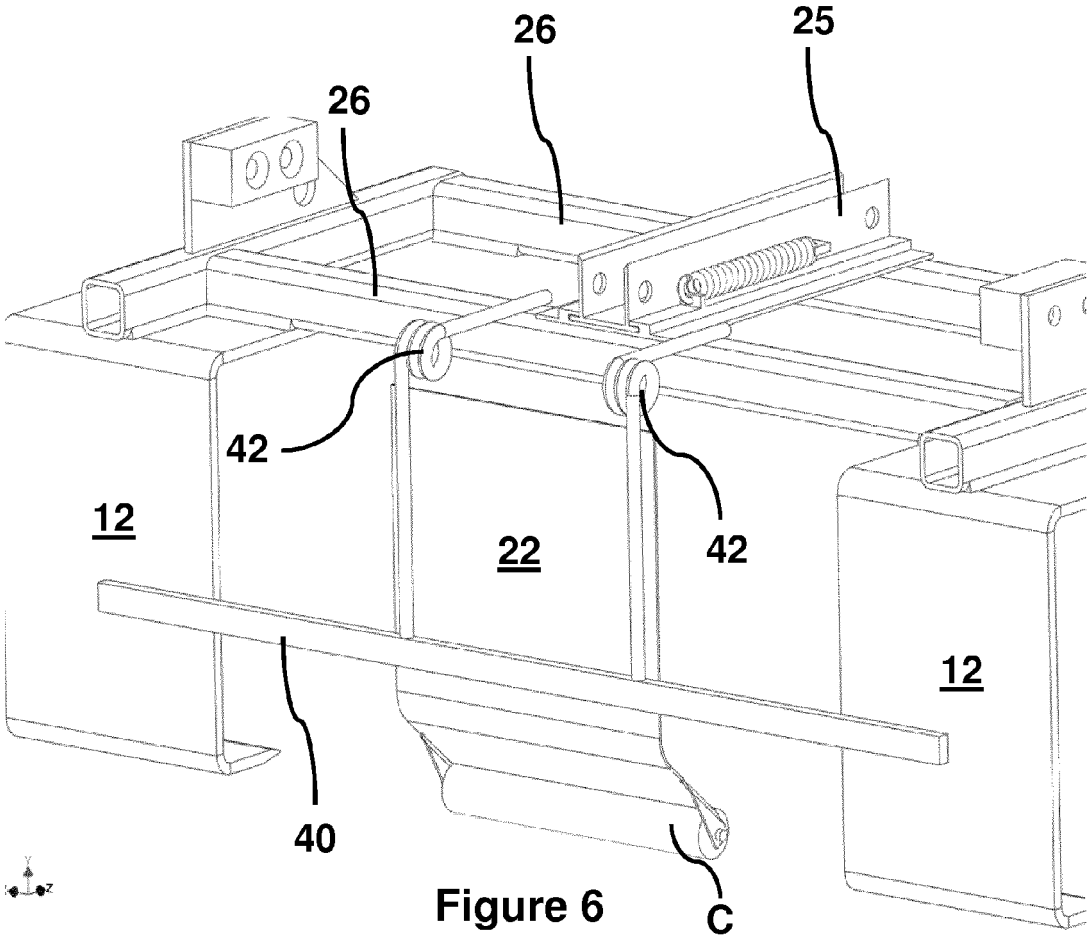



Figure 6

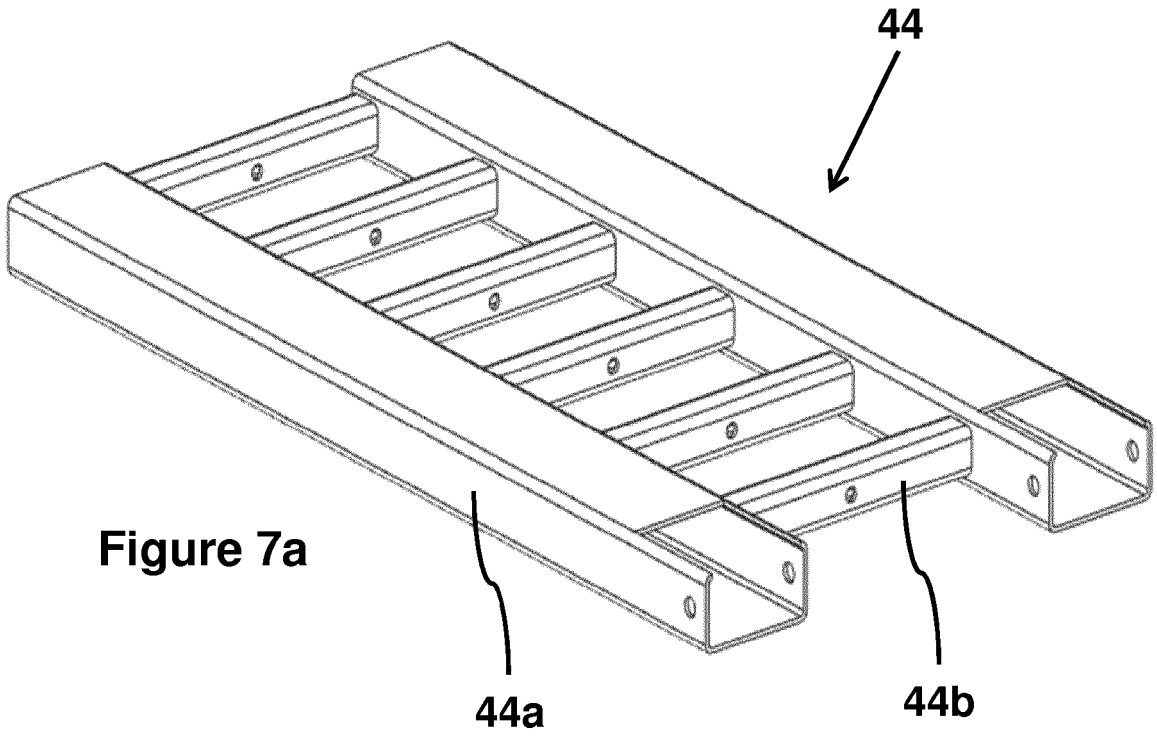



Figure 7a

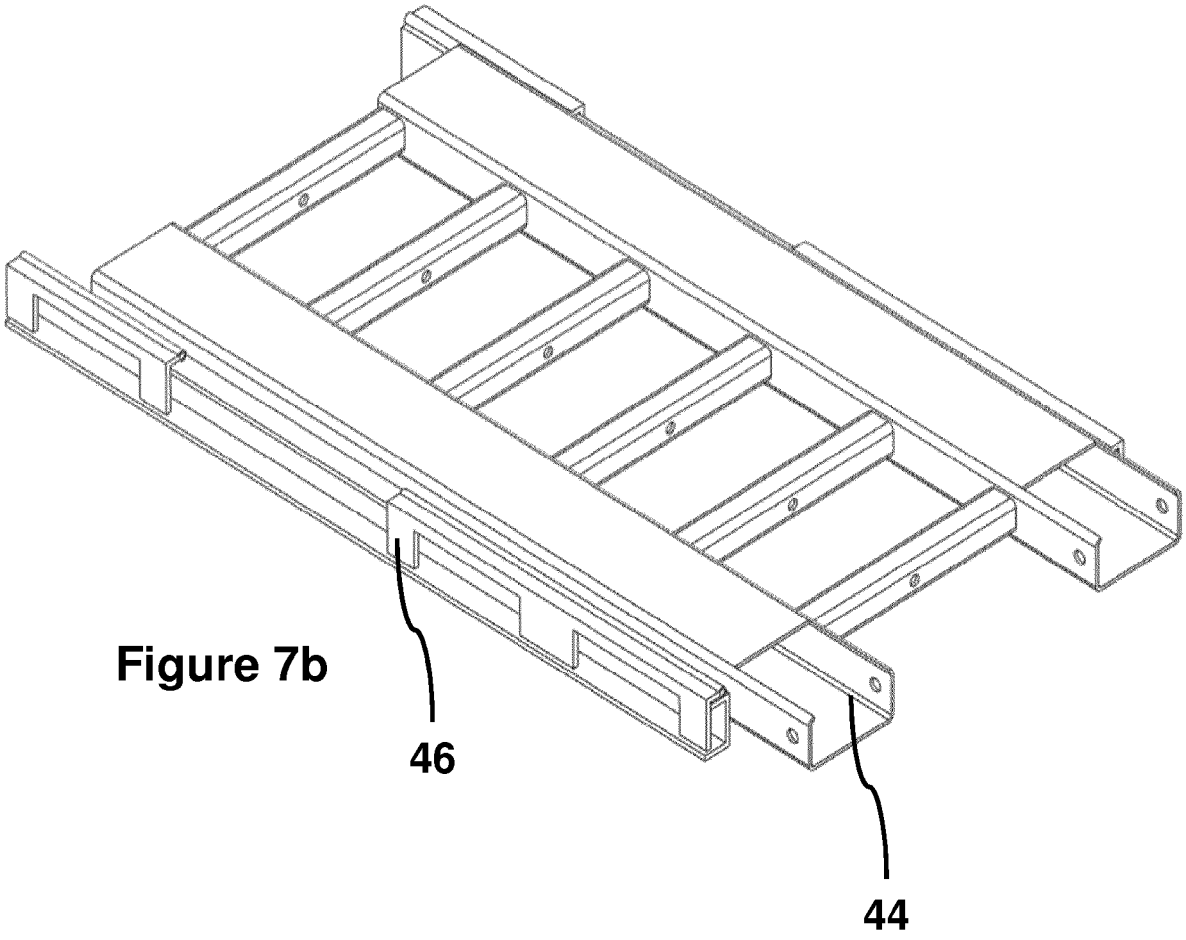



Figure 7b

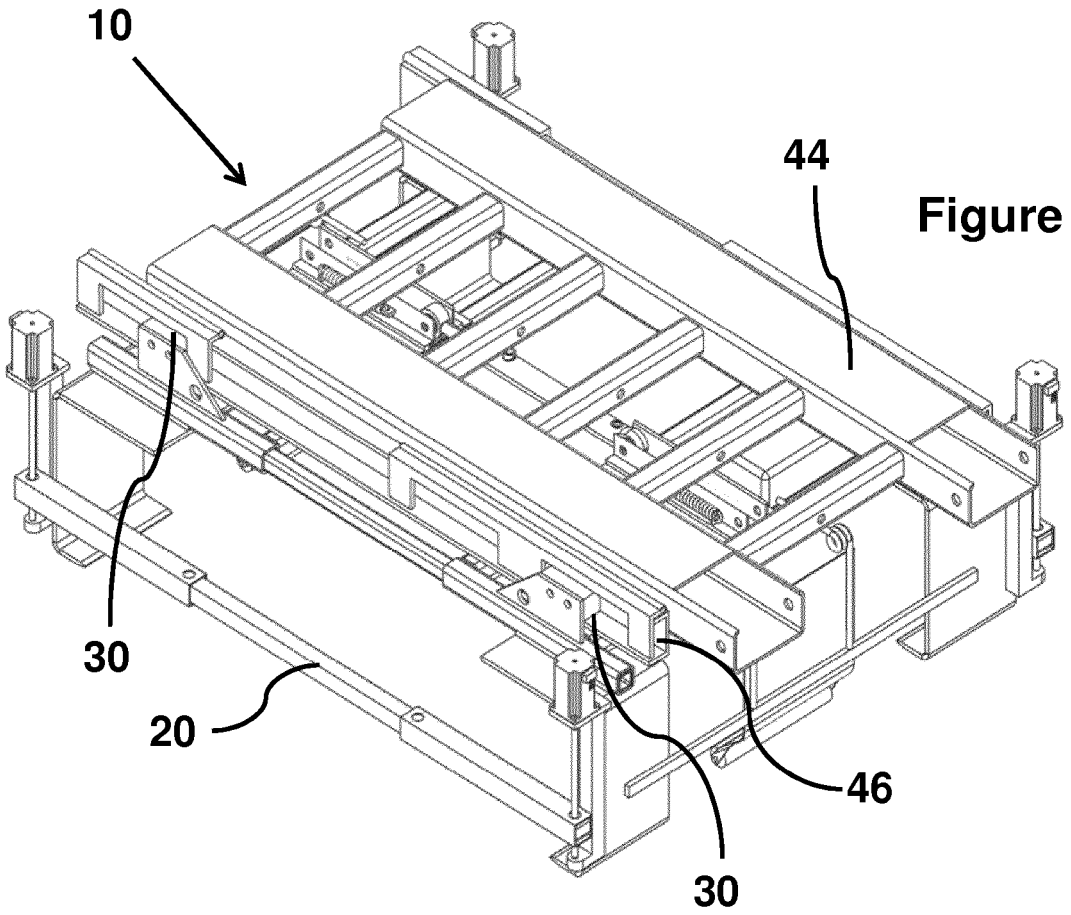



Figure 8a

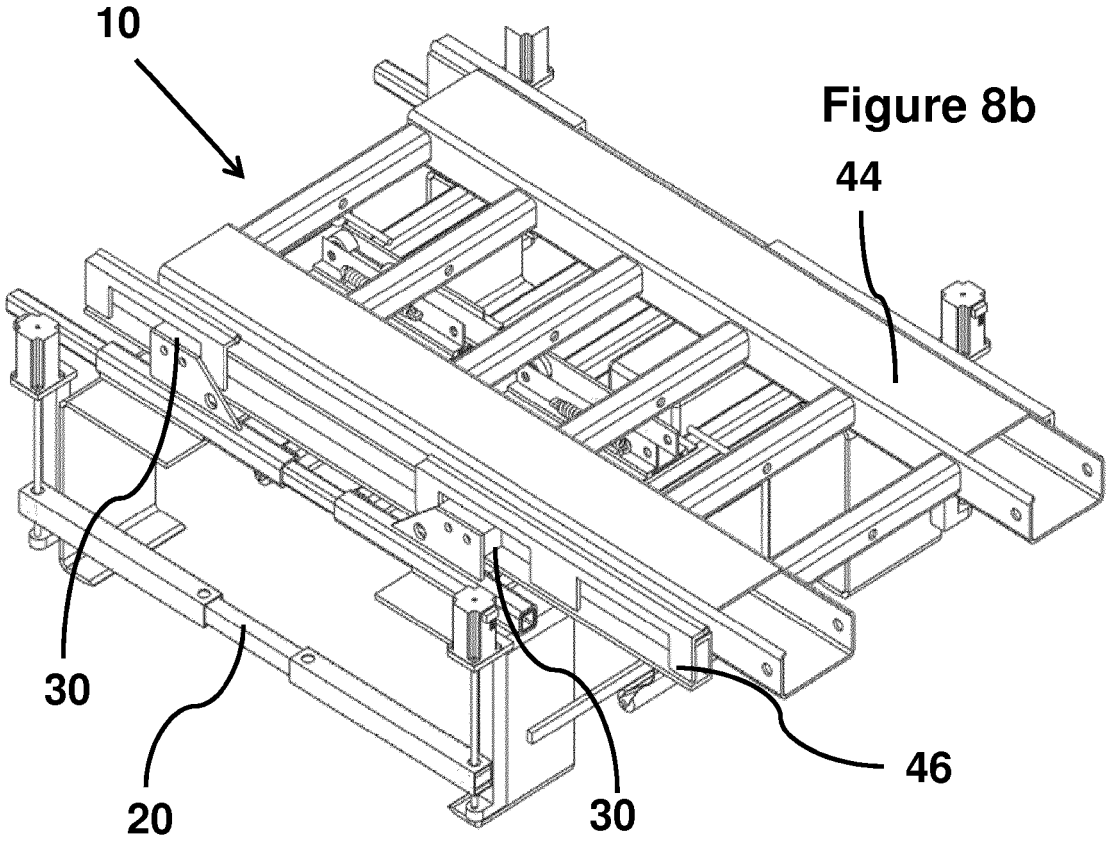



Figure 8b

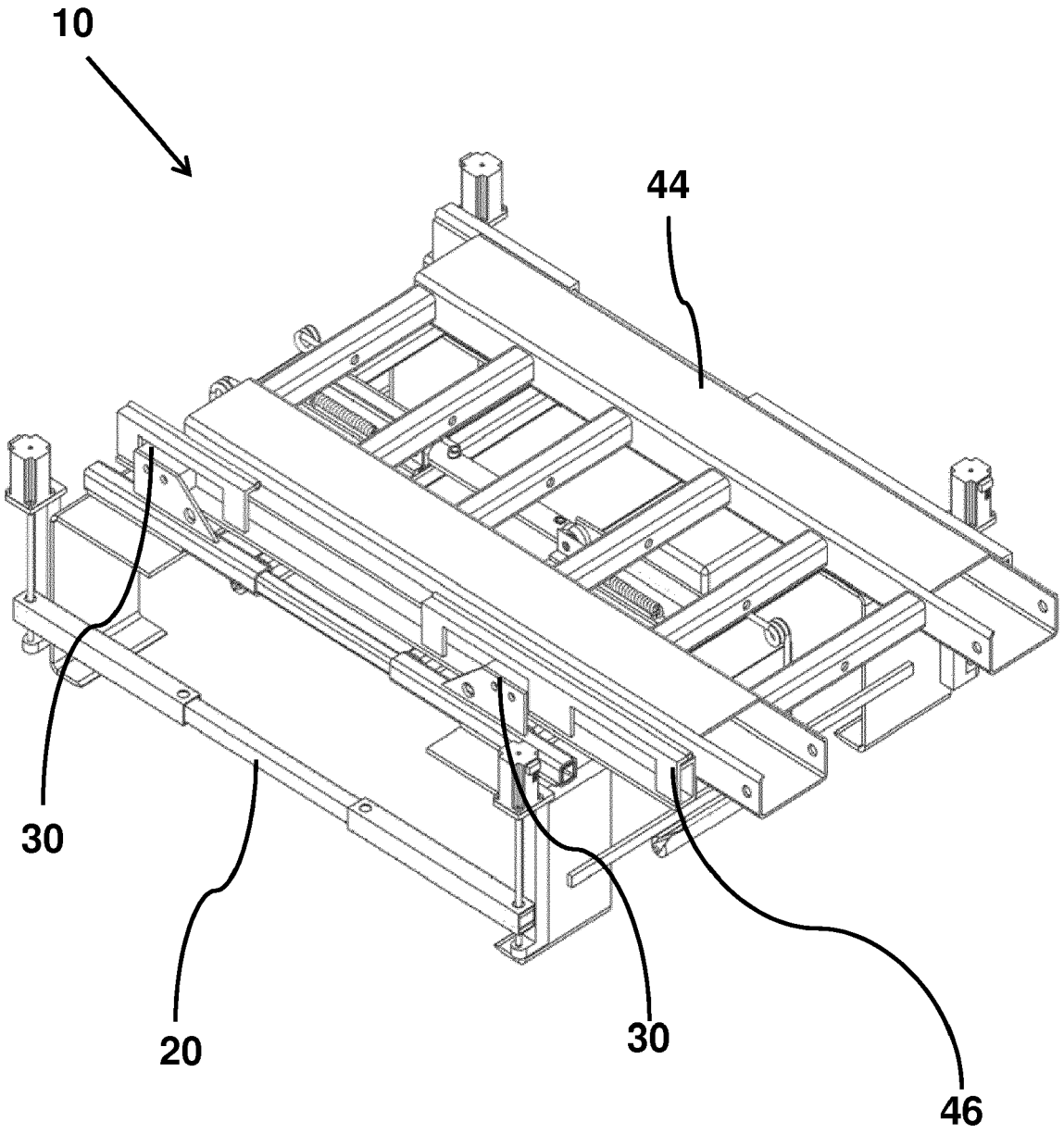



Figure 8c

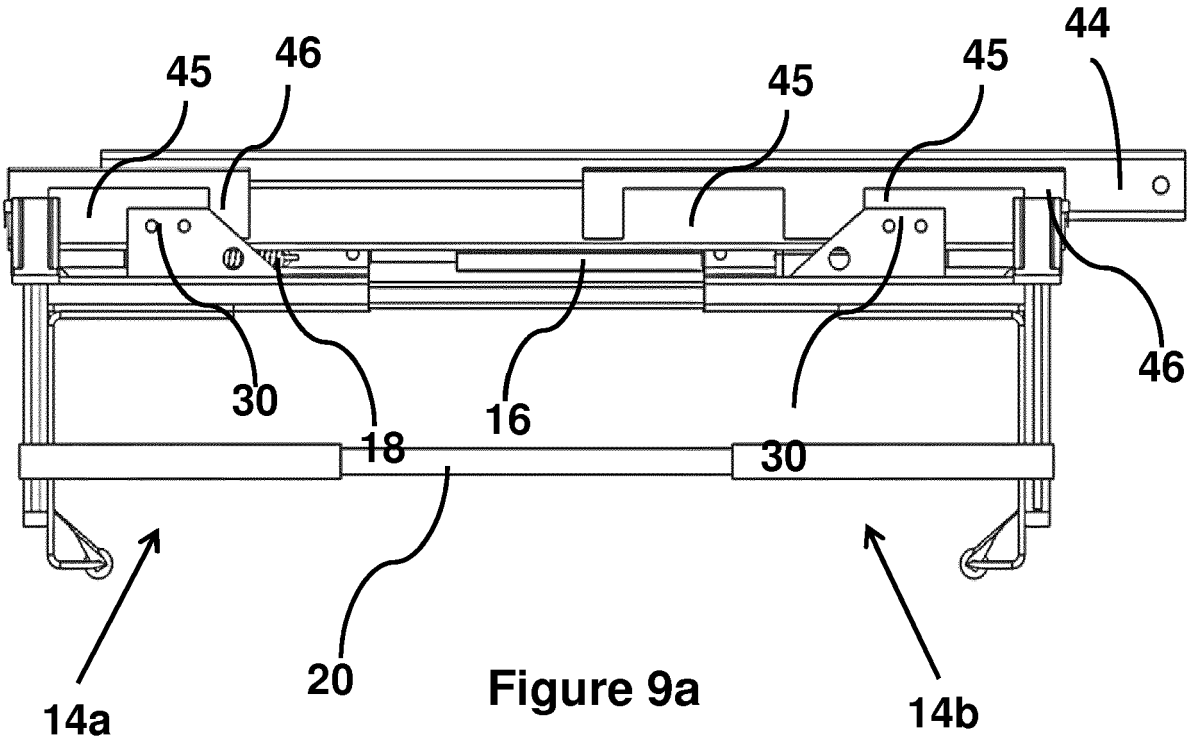



Figure 9a

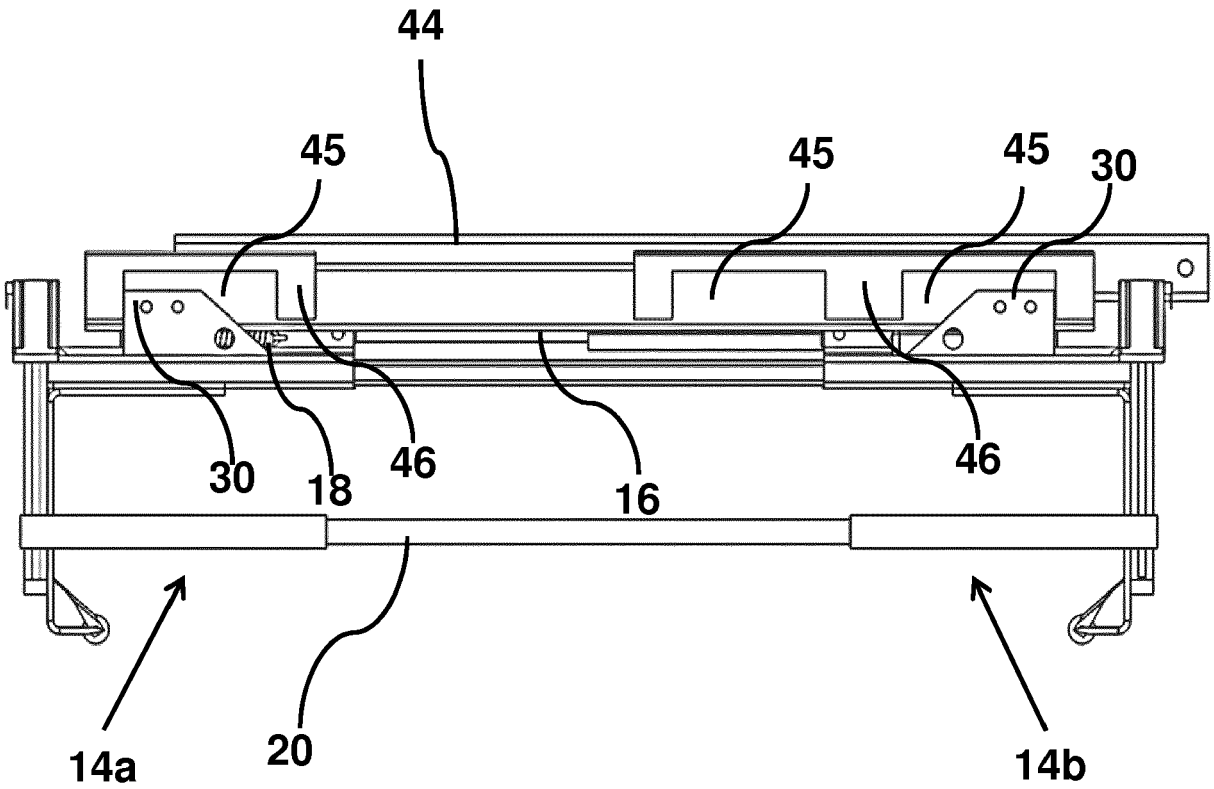



Figure 9b

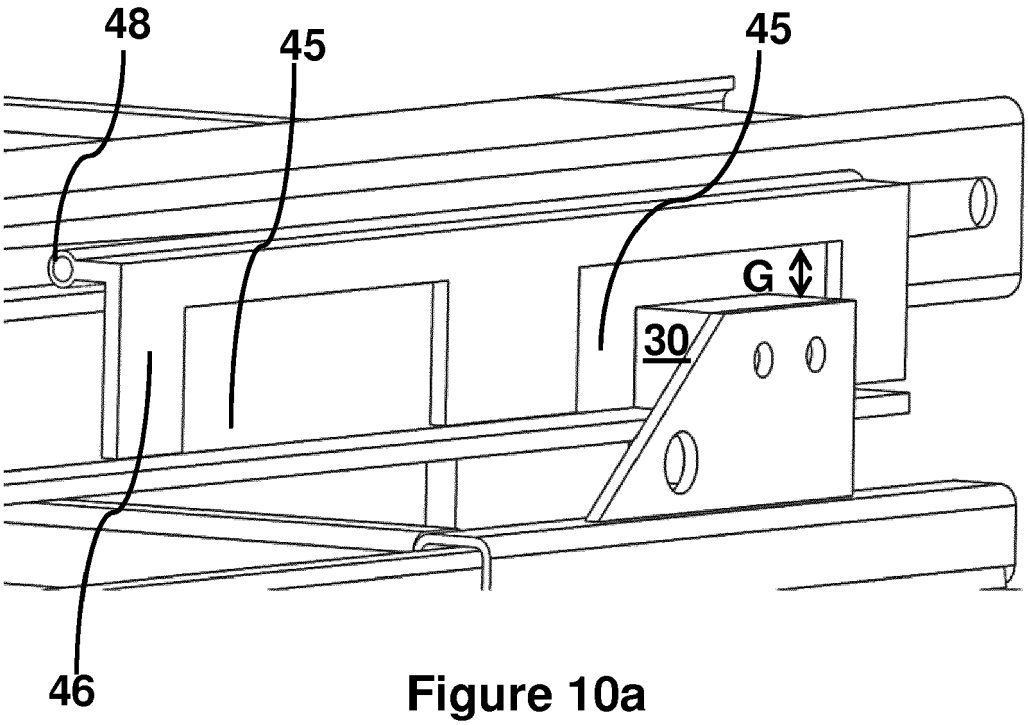



Figure 10a

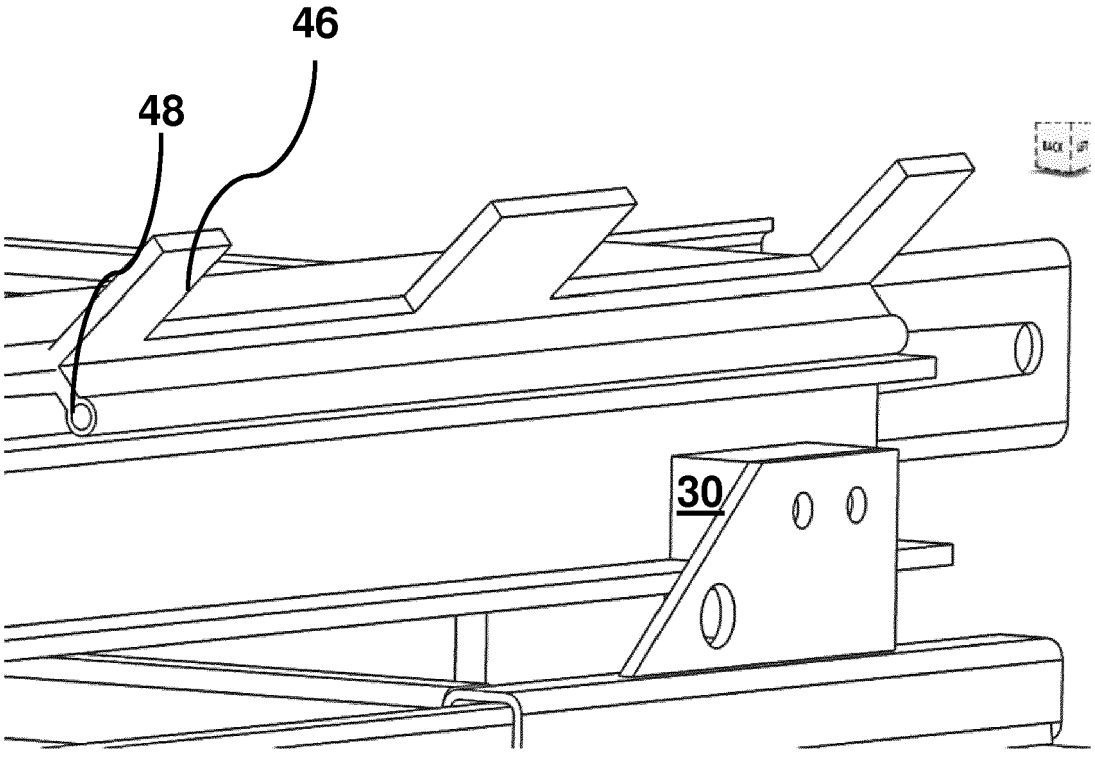



Figure 10b

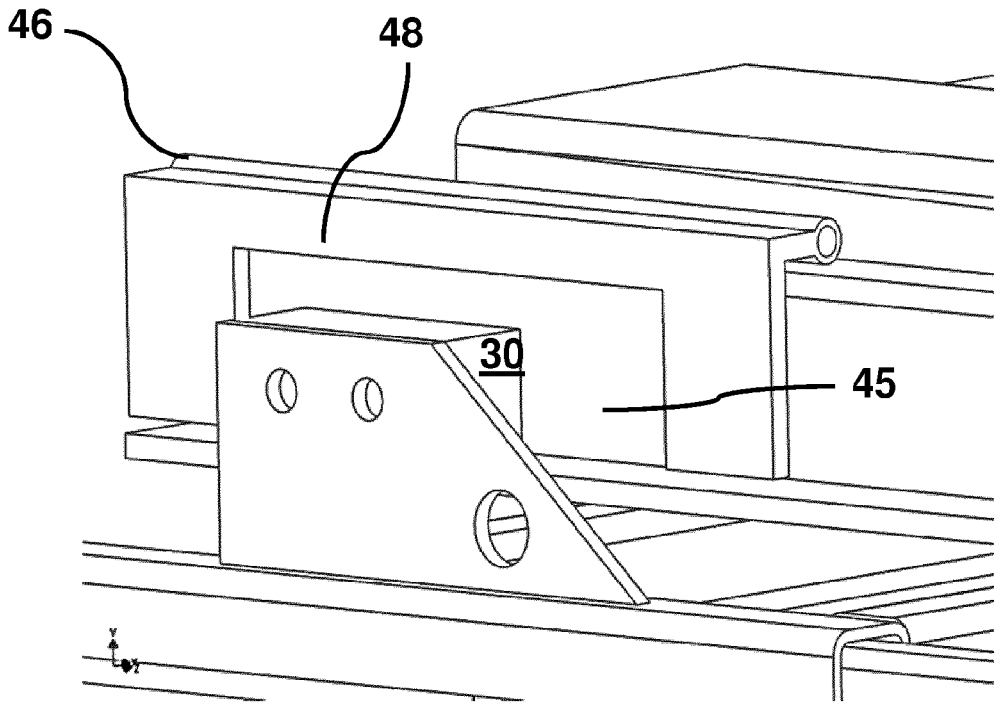



Figure 11a

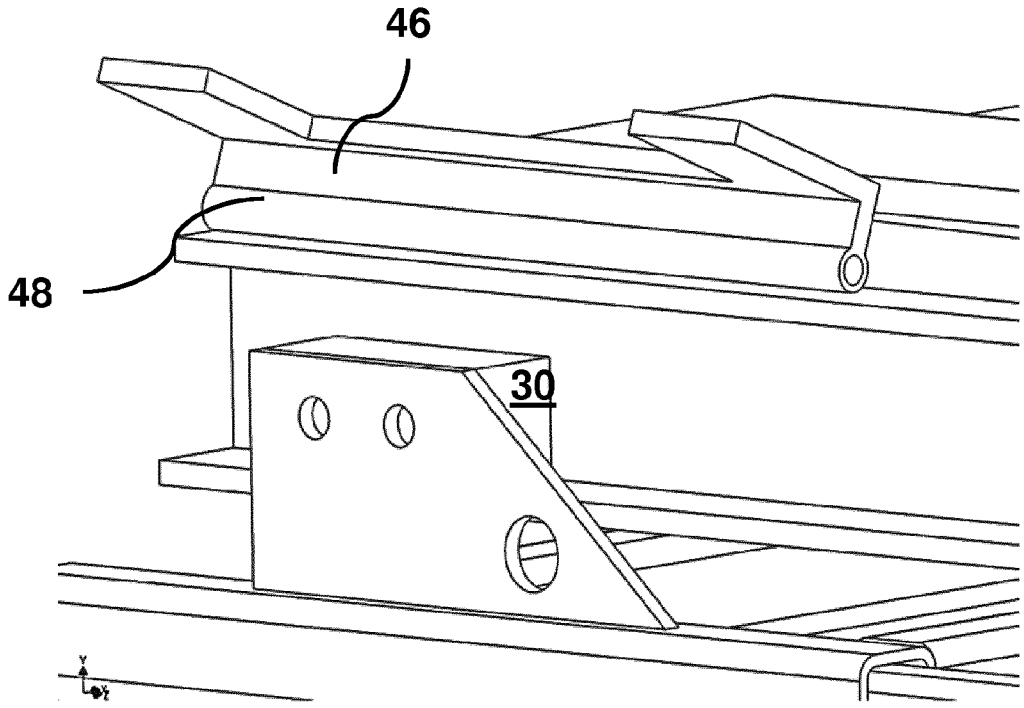



Figure 11b

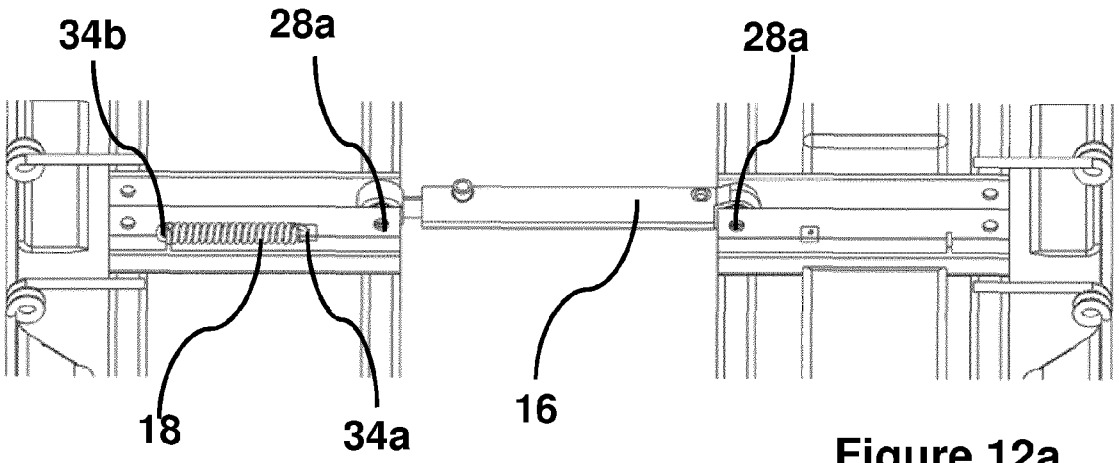



Figure 12a

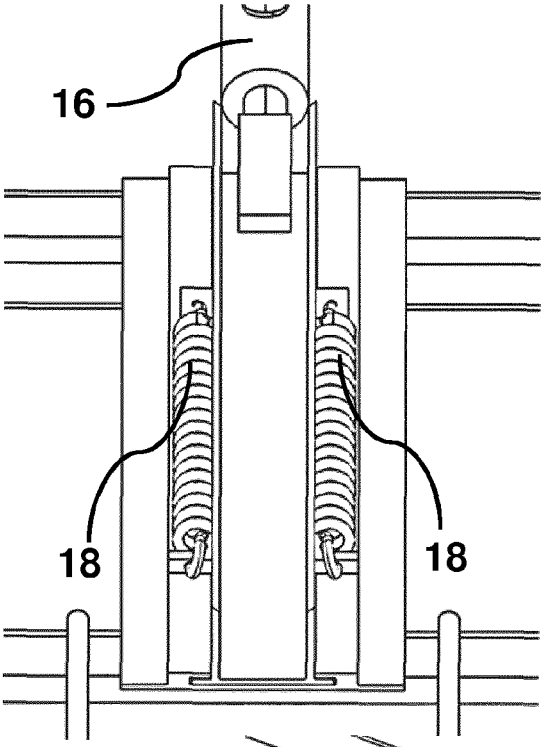



Figure 12b

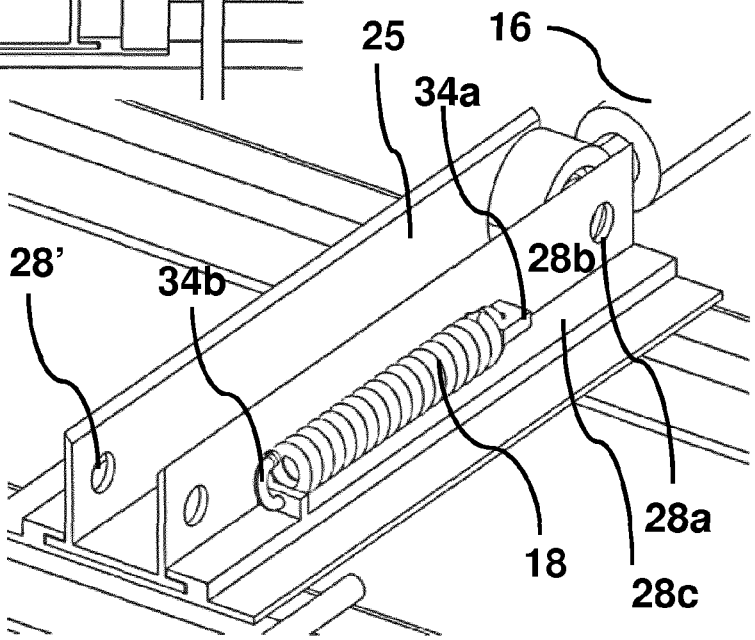
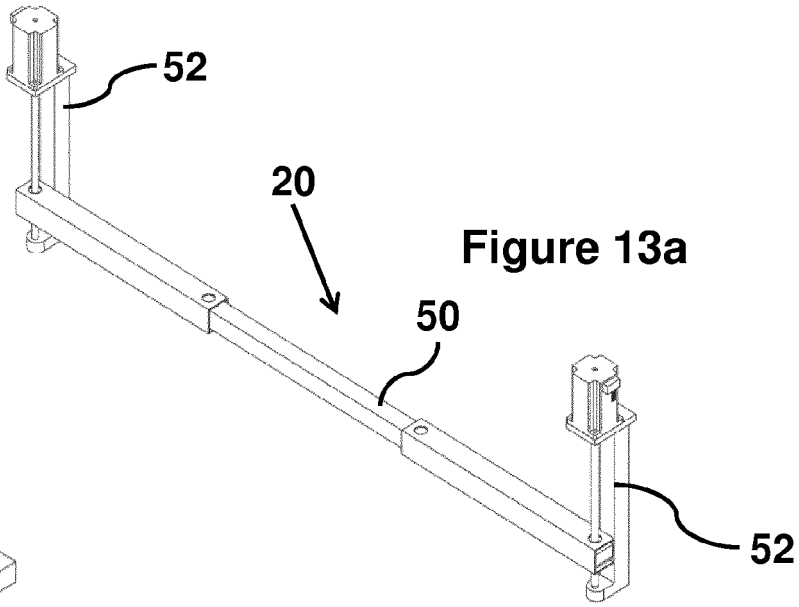



Figure 12c

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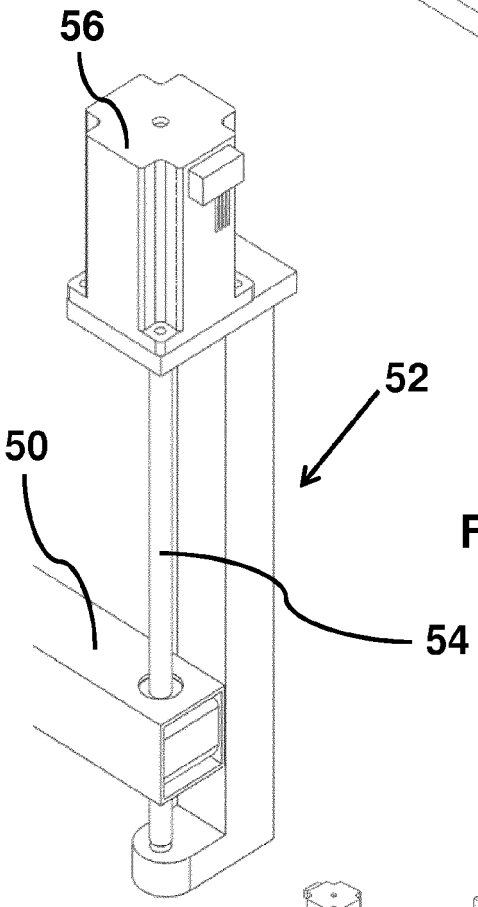
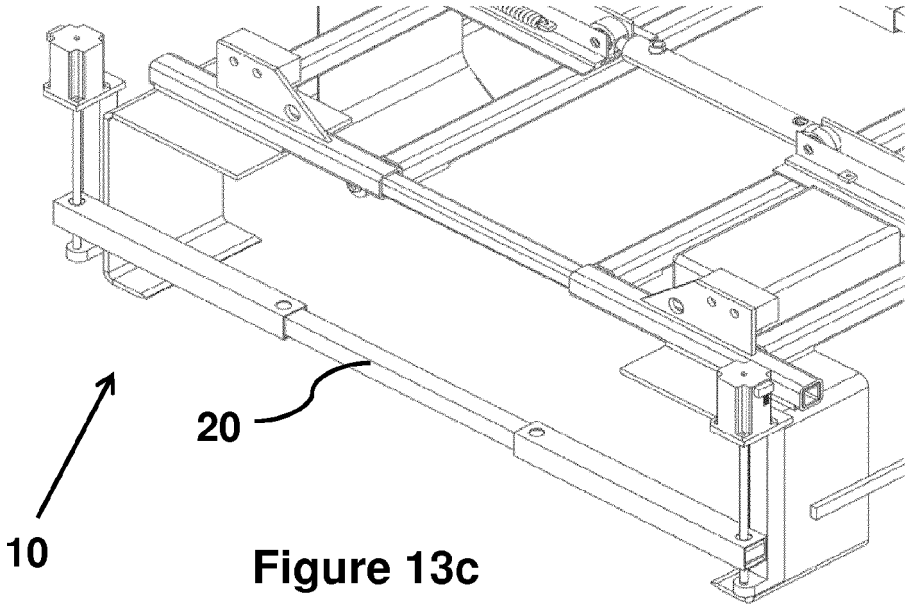



Figure 13b

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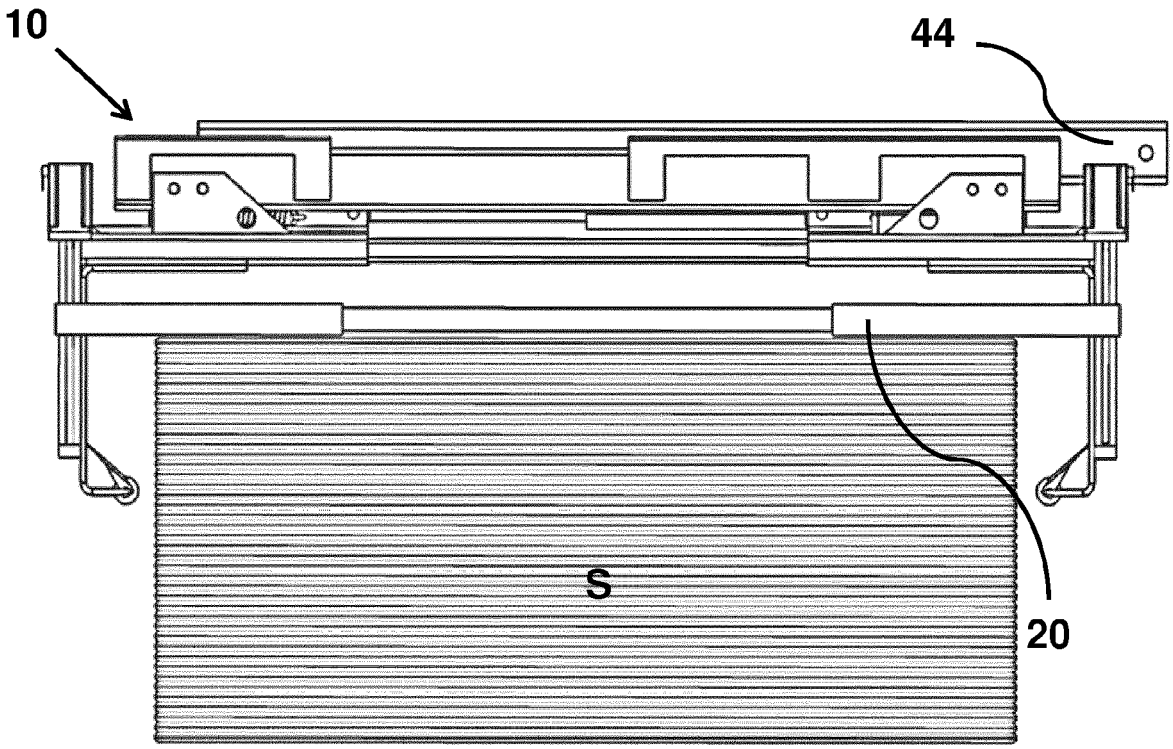


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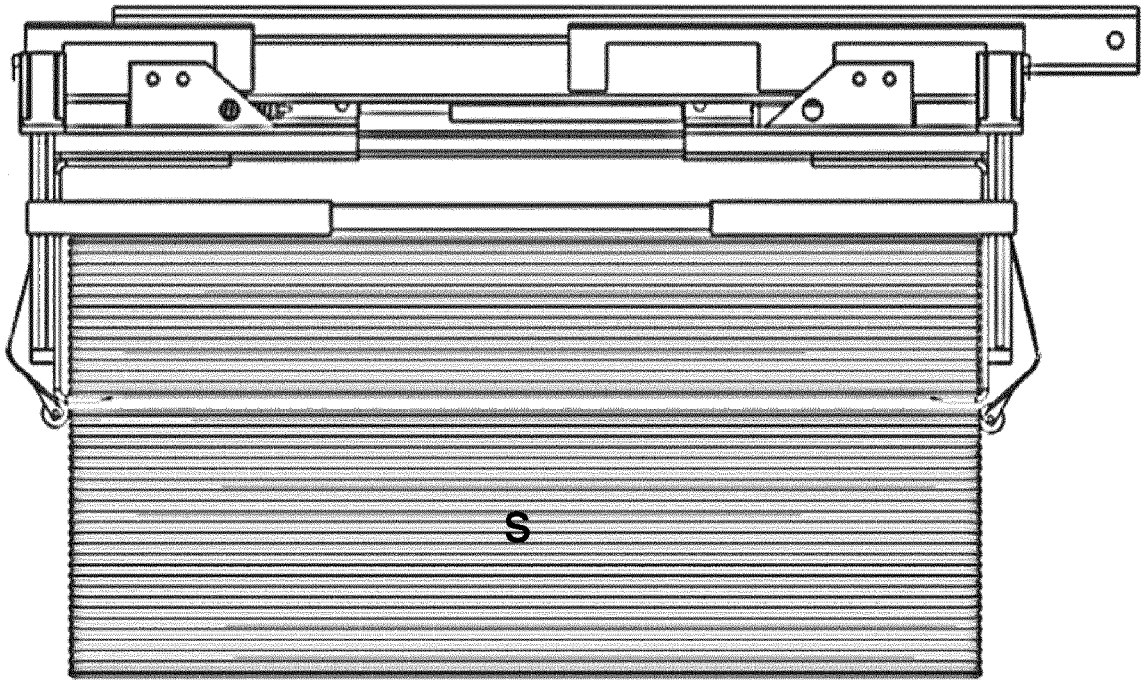


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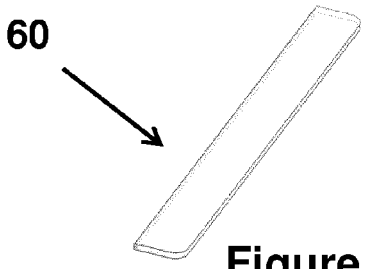



Figure 15a


Figure 15b


Figure 15c

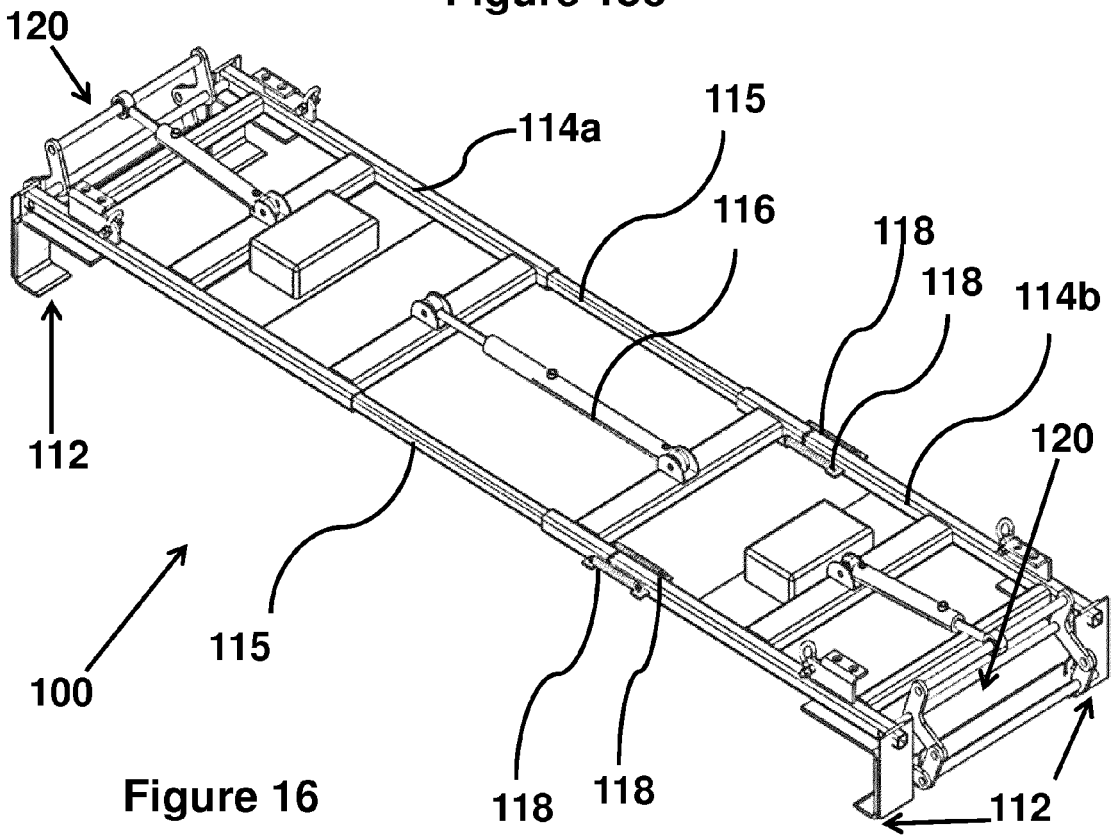



Figure 16

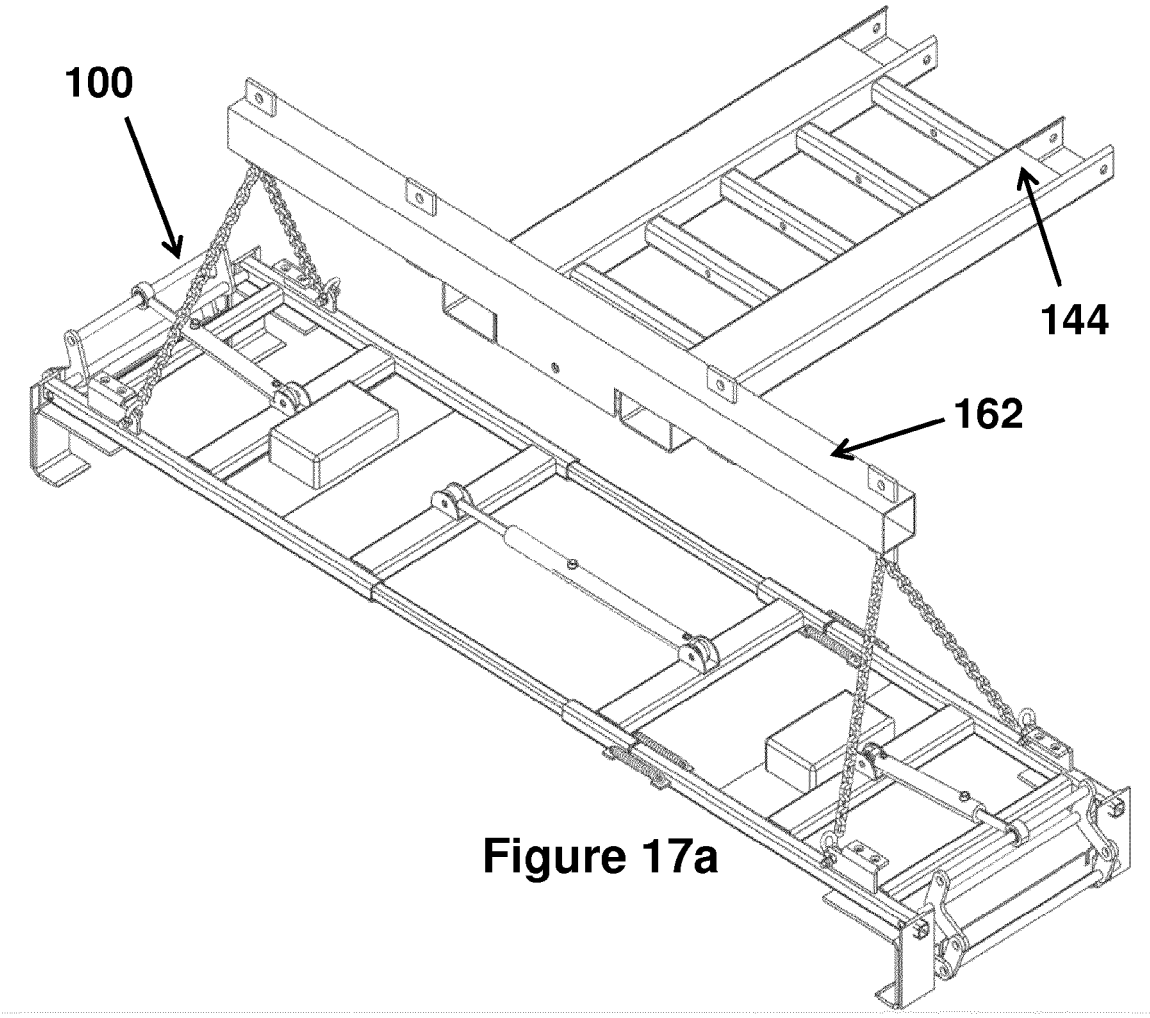



Figure 17a

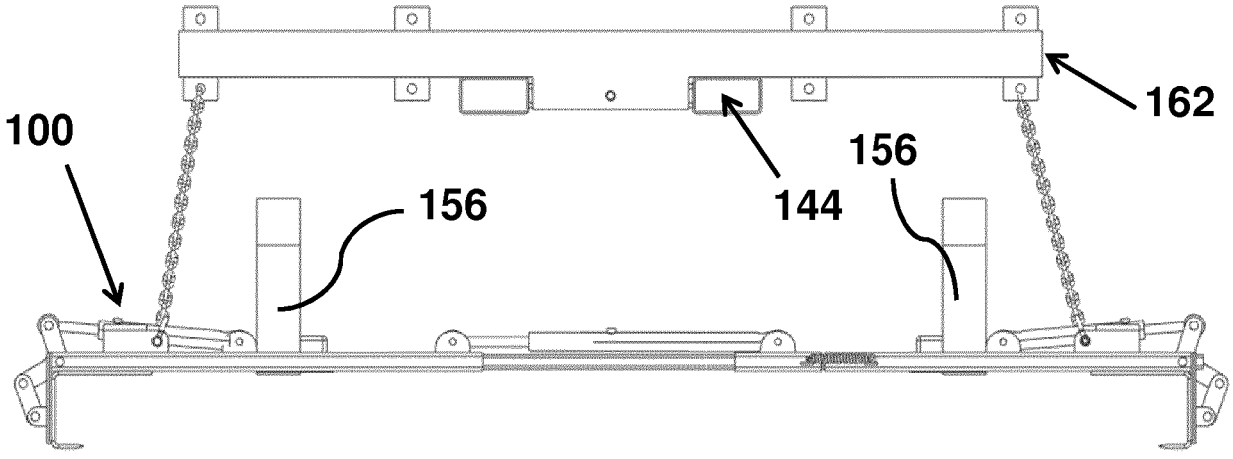
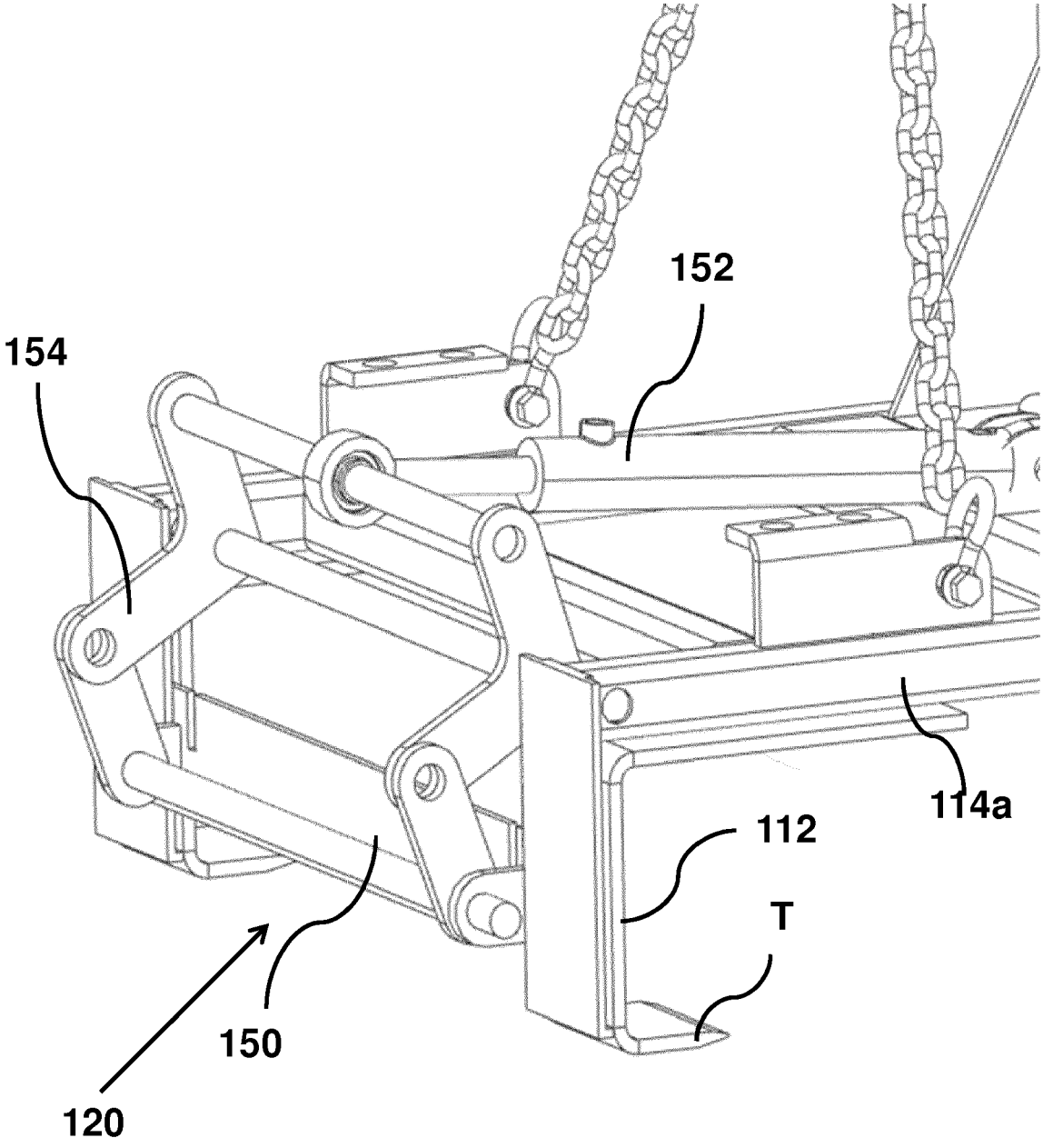



Figure 17b

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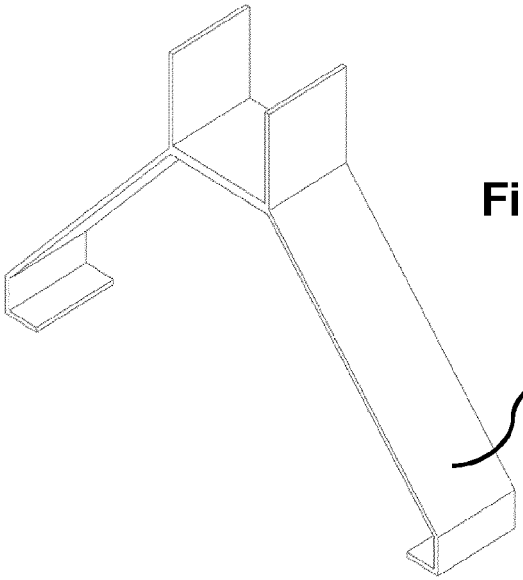


Figure 18b

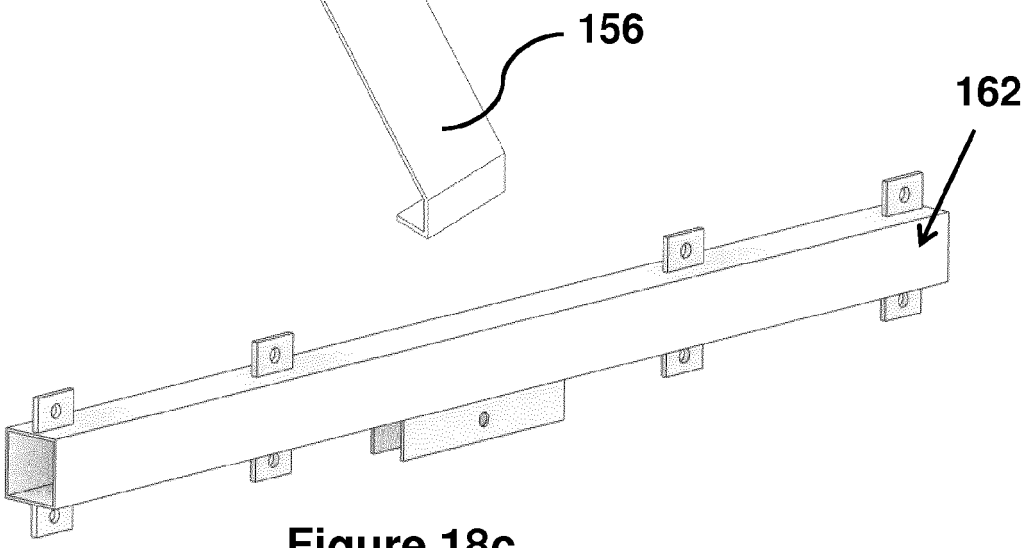



Figure 18c

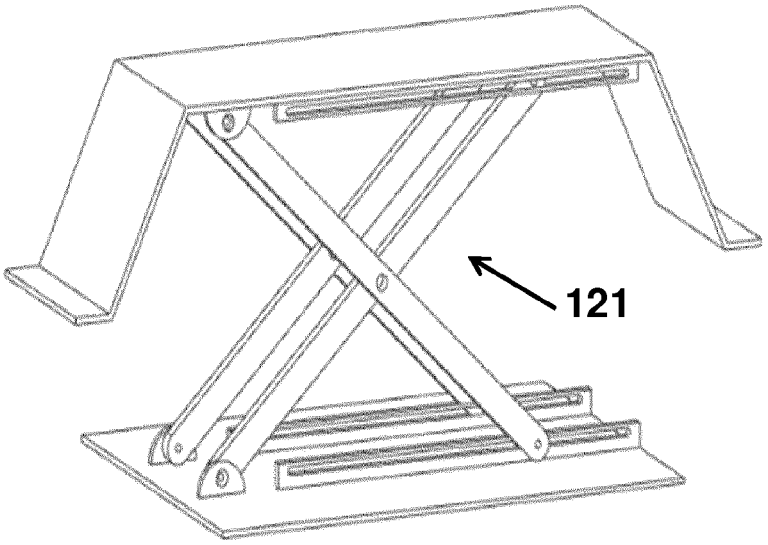



Figure 18d

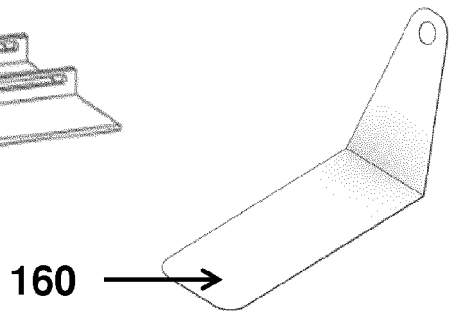



Figure 19

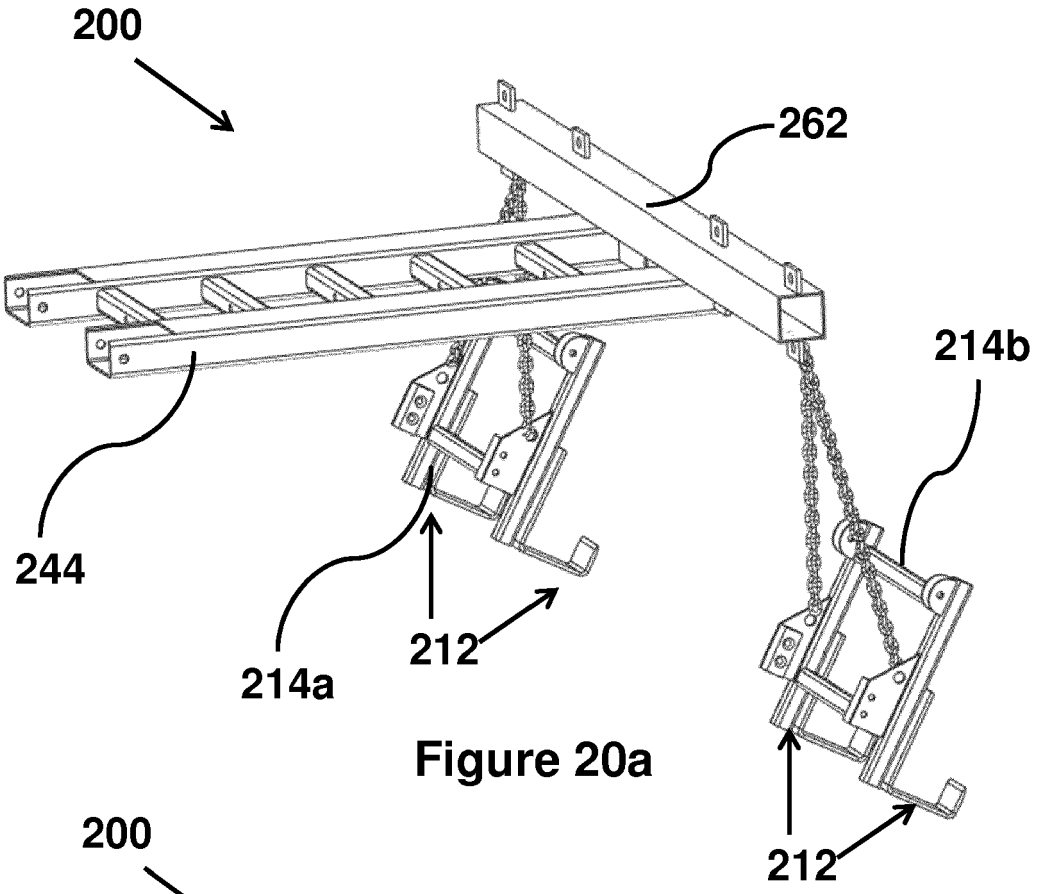



Figure 20a

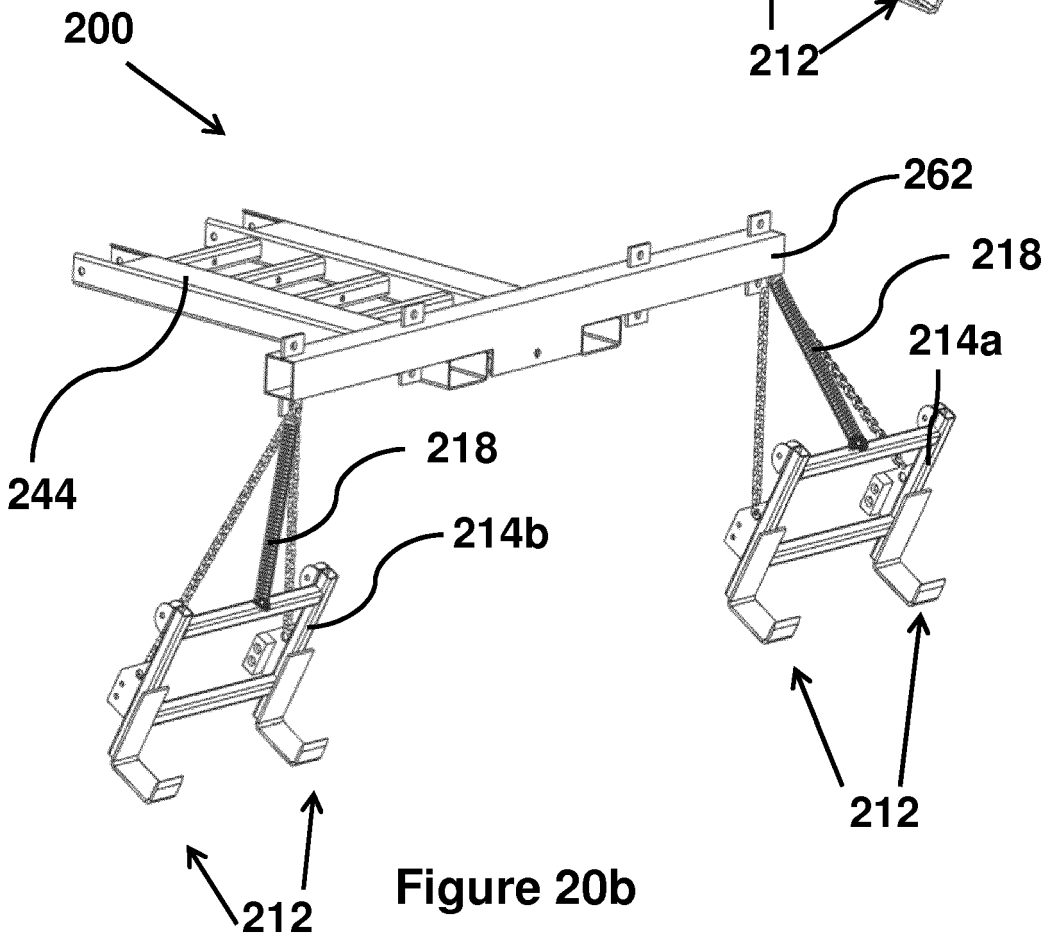



Figure 20b

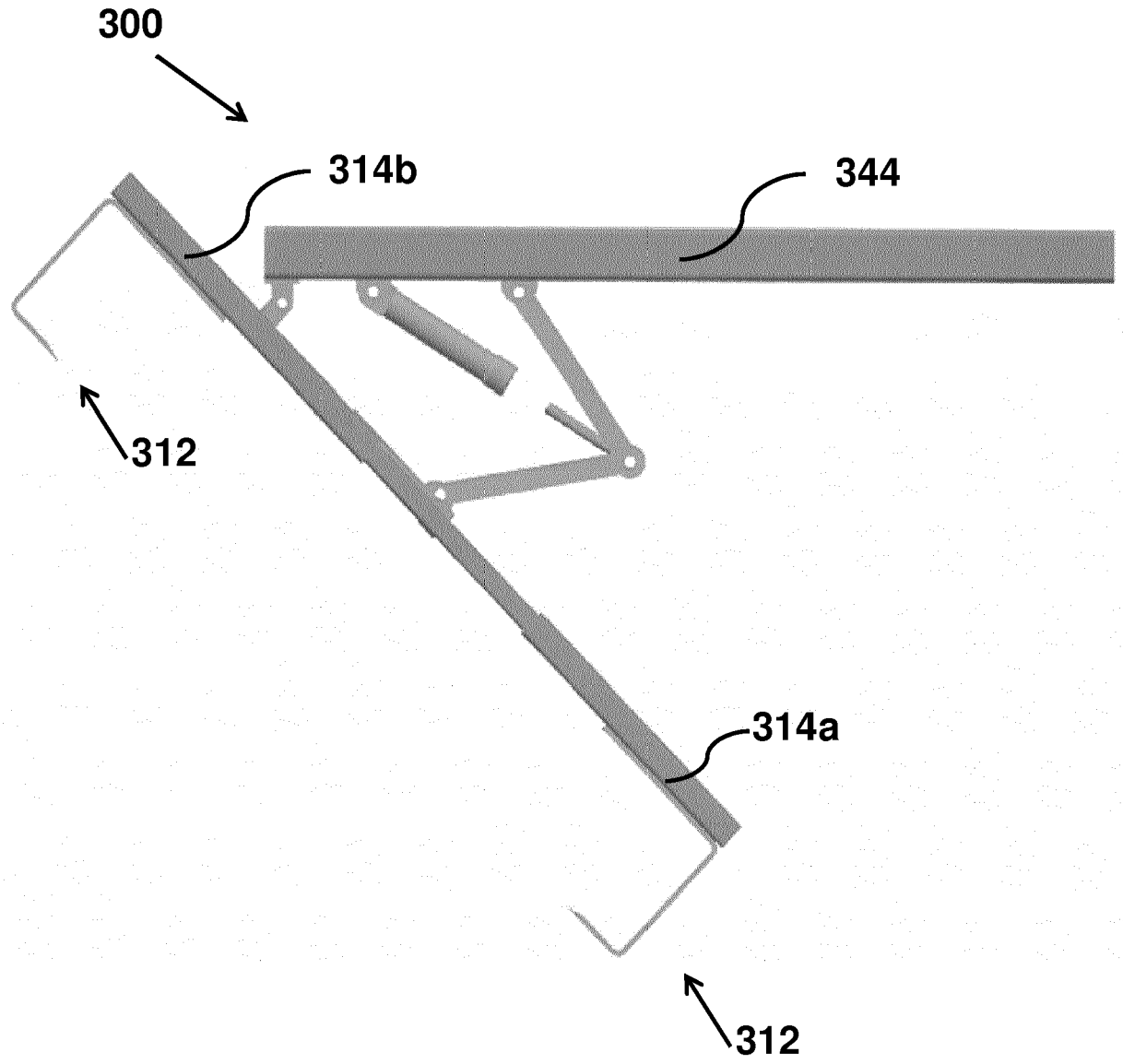



Figure 21

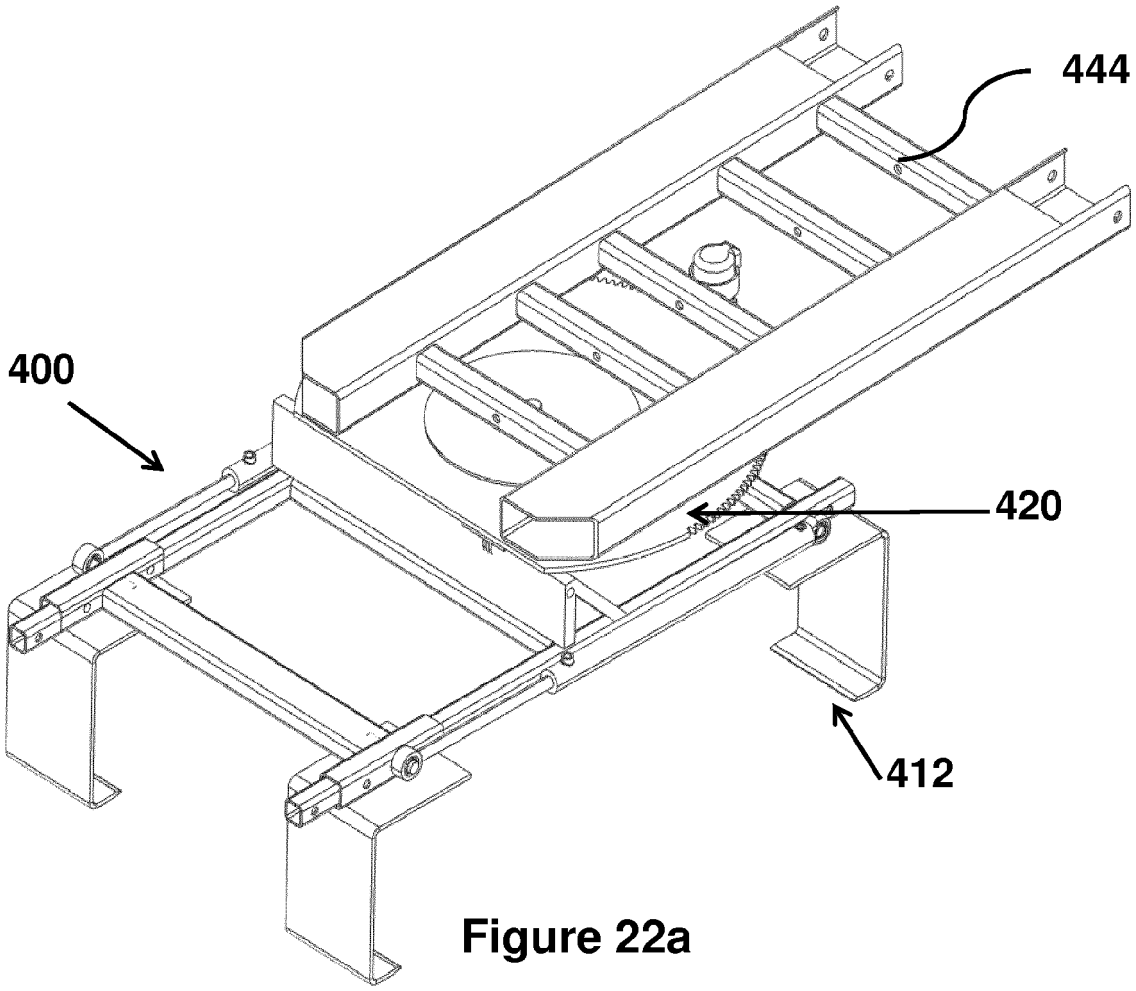



Figure 22a

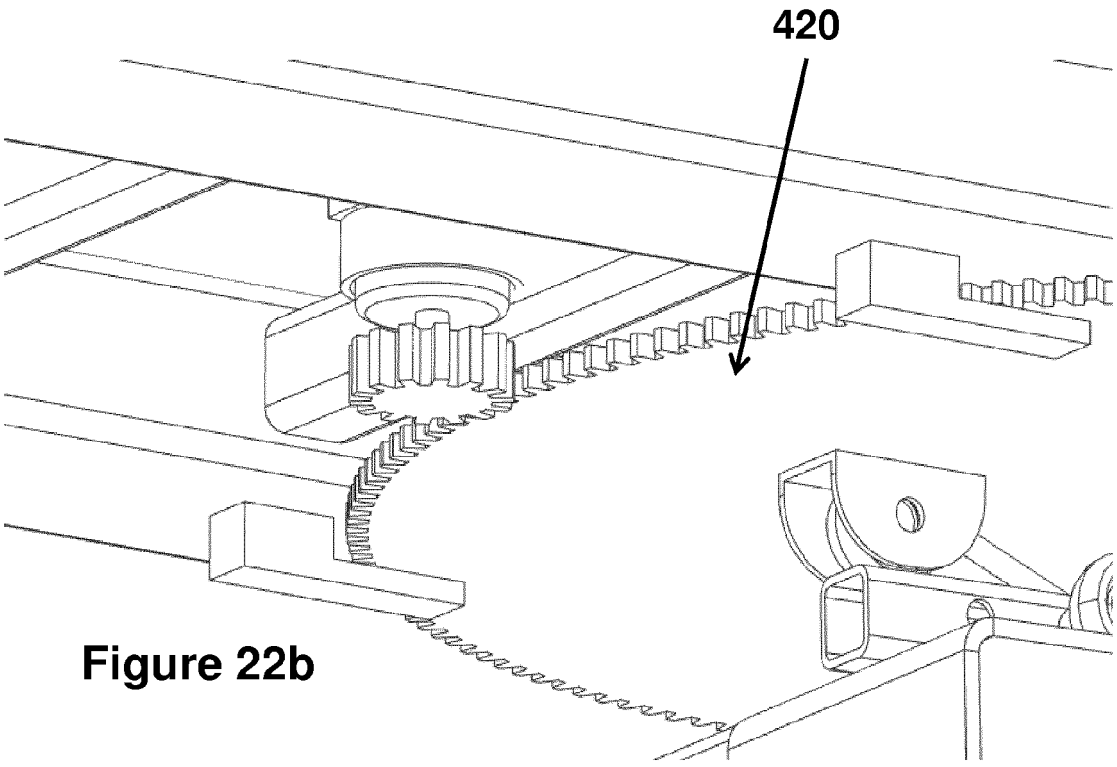



Figure 22b

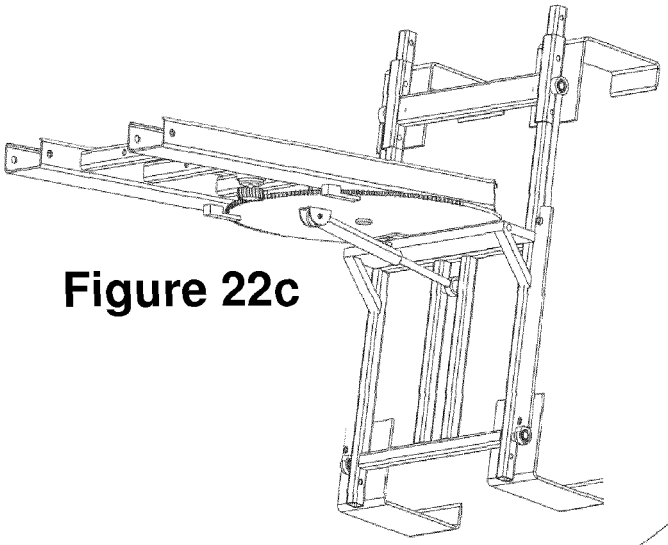


Figure 22c

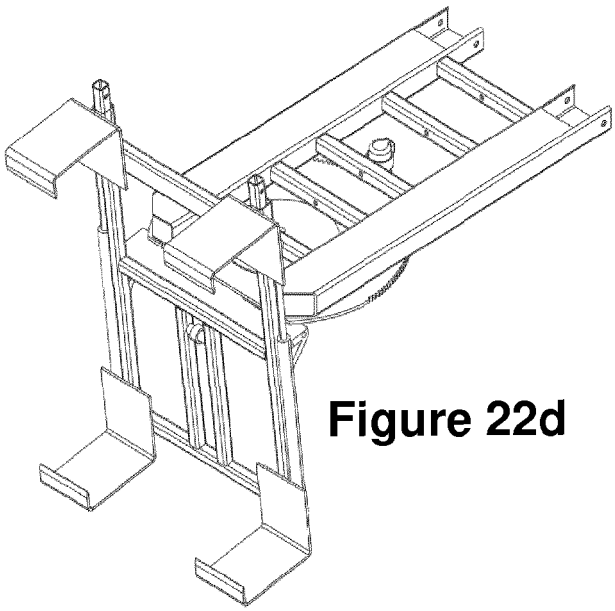


Figure 22d

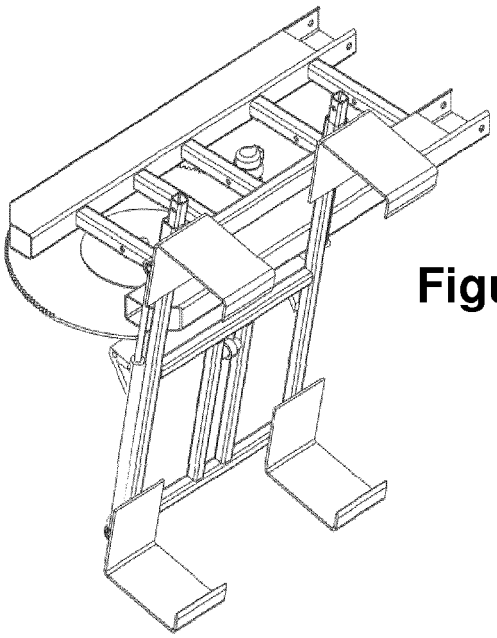


Figure 22e

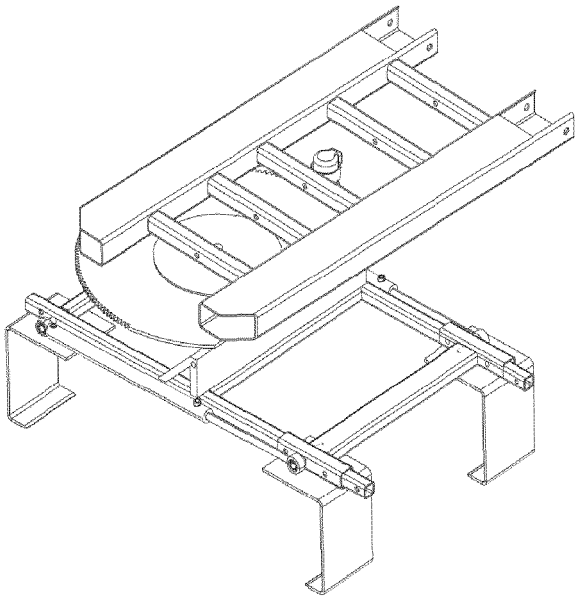


Figure 22f

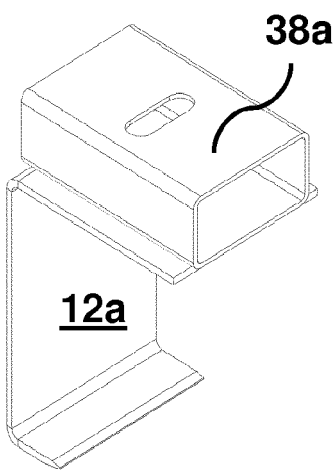



Figure 23a

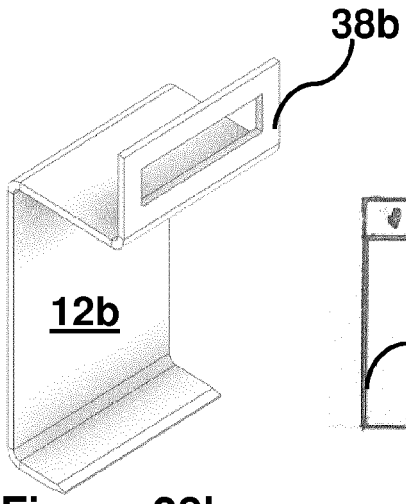



Figure 23b

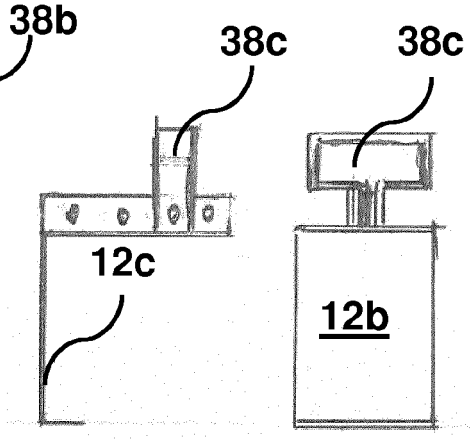



Figure 23c

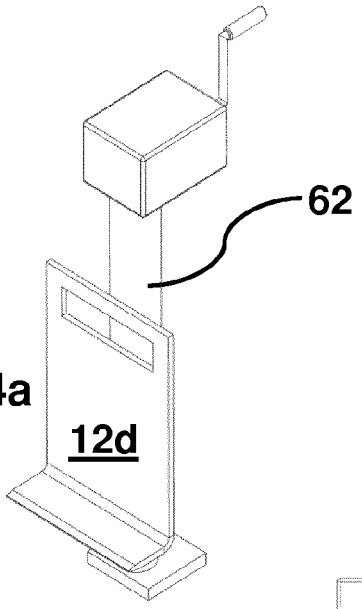



Figure 24a

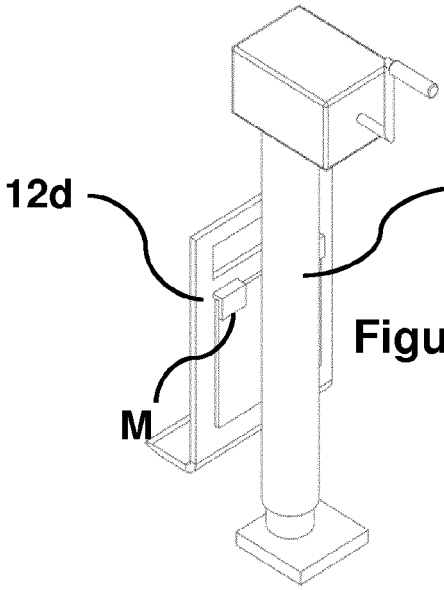



Figure 24b

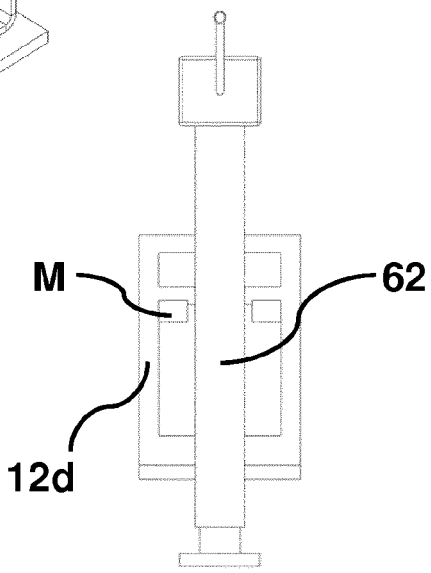



Figure 24c

Figure 25a

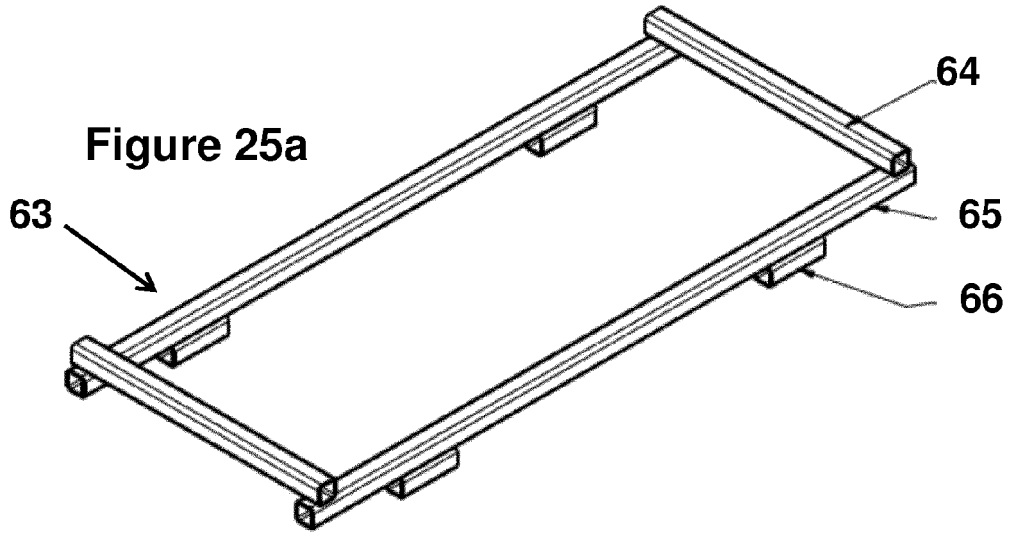
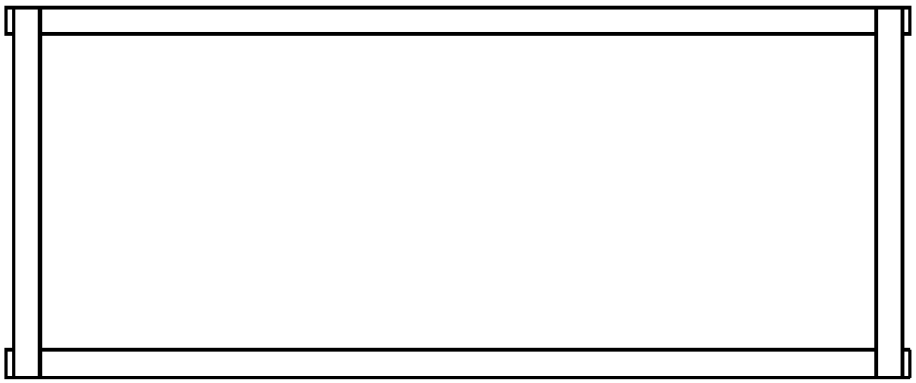



Figure 25b



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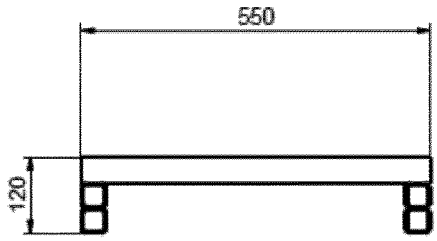


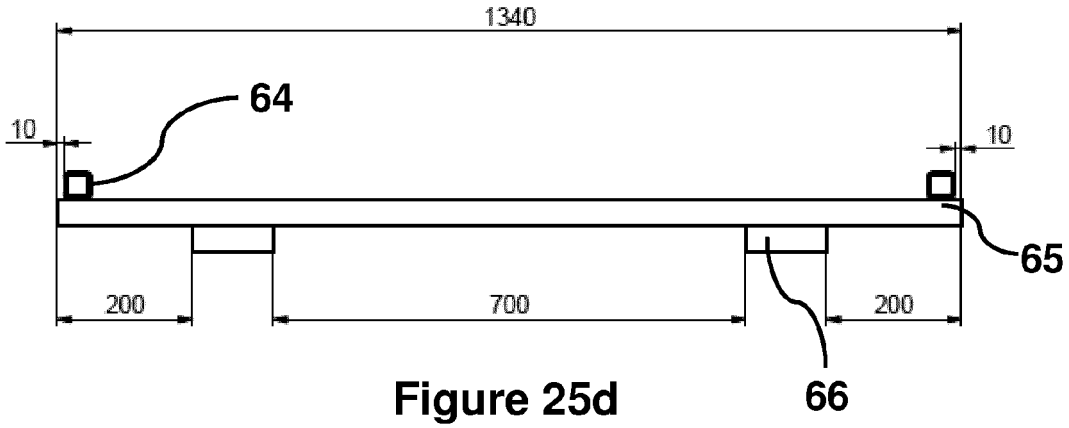
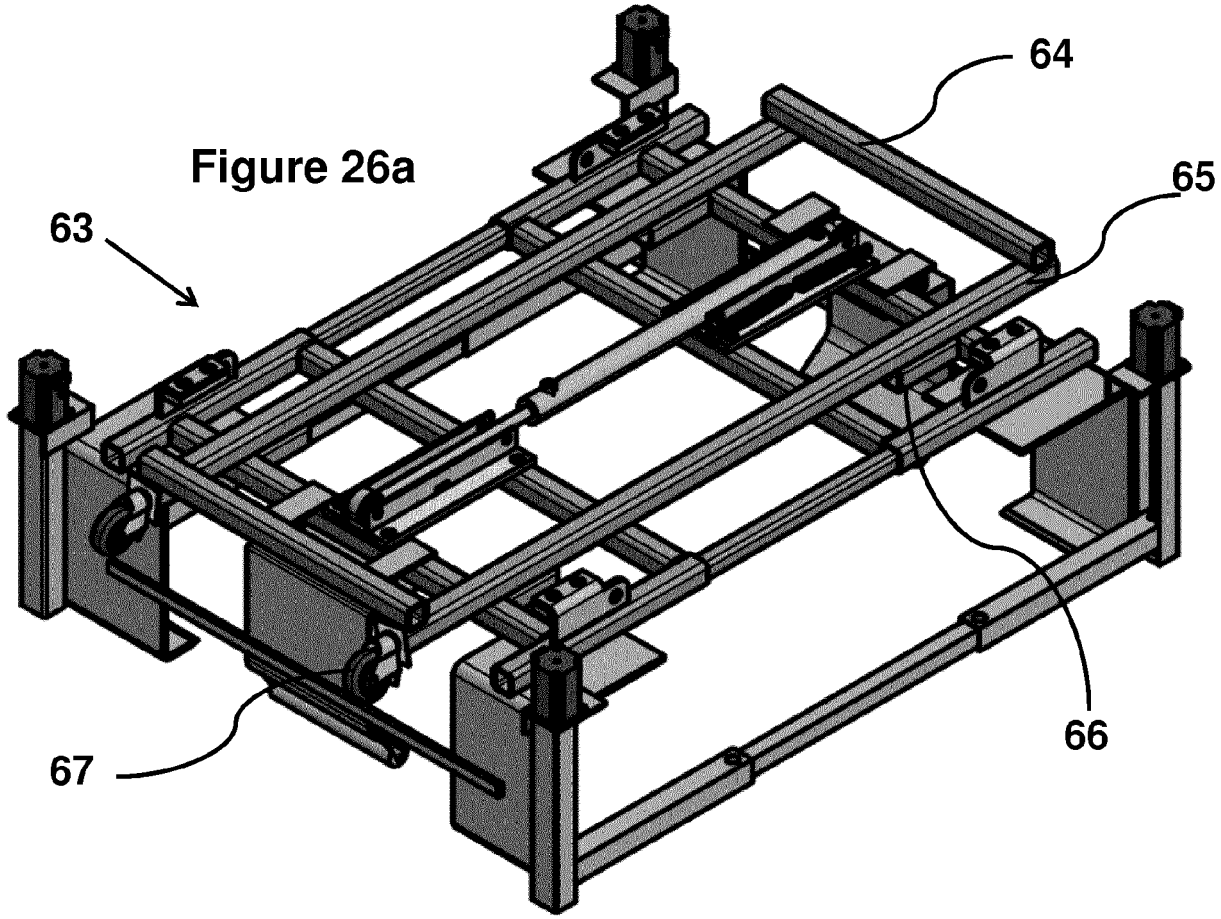




Figure 25d

Figure 26a



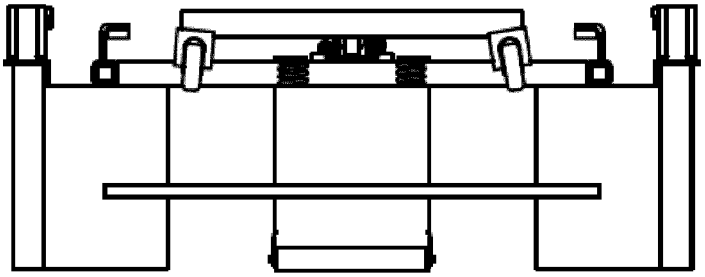
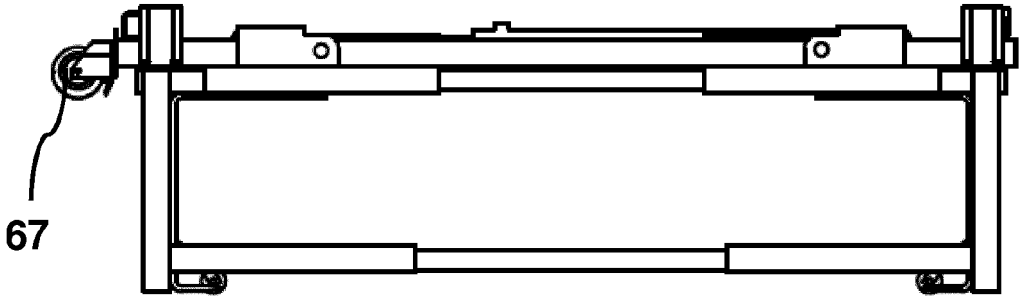



Figure 26b

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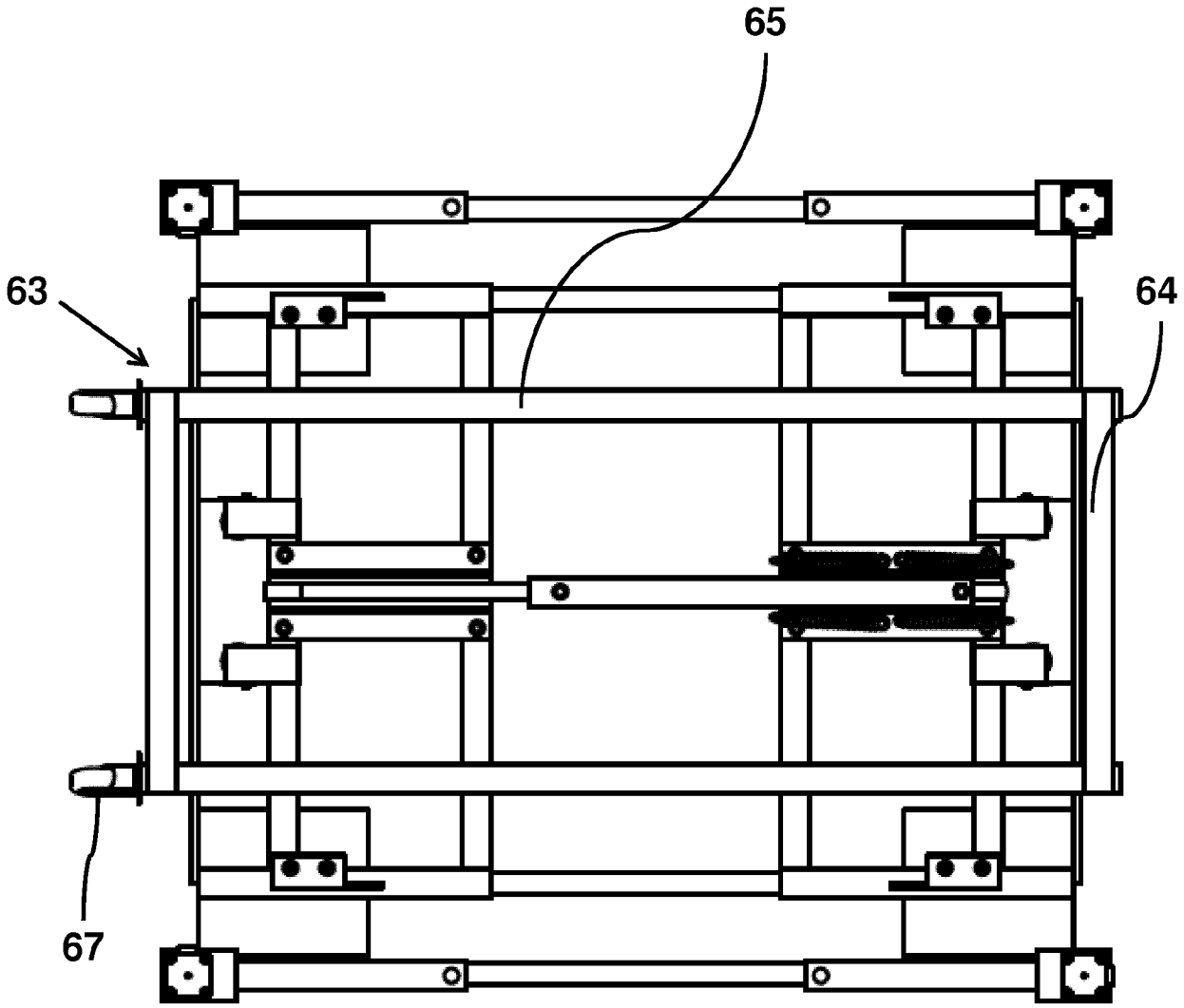


Figure 26d

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# EUROPEAN SEARCH REPORT

Application Number
EP 19 20 3701

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
|---|---|---|---|
| X<br>Y | NZ 541 816 A (ALLAN JOHN LAWRENCE SCOTT) 28 November 2008 (2008-11-28)<br>* abstract; figures *<br>* page 16, line 10 - page 21 *<br>----- | 1-3,5-8, 12,13<br>4,9-11 | INV.<br>B66C1/16<br>B66F9/12 |
| X | DE 20 2006 004889 U1 (TEUTO BAUSTAHLMATTEN) 29 June 2006 (2006-06-29)<br>* the whole document *<br>----- | 1-3,5-8, 12 | |
| Y<br>A | US 2012/153654 A1 (COLE JERRY ALAN [US]) 21 June 2012 (2012-06-21)<br>* abstract; figure 1 *<br>* paragraph [0035] *<br>----- | 4,9,10<br>1 | |
| Y<br>A | GB 1 267 178 A (PETER SCHUBERT) 15 March 1972 (1972-03-15)<br>* abstract; figures 1,3 *<br>----- | 11<br>1 | |
| X<br>A | US 4 542 928 A (FOWLER JR AUBREY A [US]) 24 September 1985 (1985-09-24)<br>* abstract; figure 1 *<br>----- | 15<br>1 | TECHNICAL FIELDS SEARCHED (IPC) |
| A | FR 2 475 515 A1 (TRANSBORDEMENTS STE MODERNE [FR]) 14 August 1981 (1981-08-14)<br>* figures *<br>----- | 1-15 | B66C<br>B66F |
| A,D | US 2008/217843 A1 (PICKARD ROBERT DAVID [GB]) 11 September 2008 (2008-09-11)<br>* abstract; figures *<br>----- | 1-15 | |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 4 March 2020 | Verheul, Omiros |

CATEGORY OF CITED DOCUMENTS

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